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Engineering News-Record

Devoted to Civil Engineering and Contracting
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Volcanic Formations Govern Design in Hydro-Electric Development

What is the Matter with Road Contracting?

Report of Annual Meeting
American Society of Civil Engineers

Pit River No. 3, Dam and Intake

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Judges or Engineers

A NUMBER of the most distinguished men in the United States, who happen to be lawyers, are uniting to advocate a higher salary scale for federal judges. It is a pity that the engineers in government service cannot call to their aid public men of comparable influence, for danger to the body politic and unfairness to the individual are resident quite as much in the low salaries paid to government engineers as to the federal judges. The latter dispense the high, low and middle justice, perhaps. But the former hold in their hands our lives, our comfort and our pocketbooks. Which are the more important?

Overcapitalizing Buildings

SOME of the interests in New York City who are concerned at what they think is overbuilding of certain kinds of structures in the metropolis are going to try to have a legislative inquiry this winter into the mortgage loan business. Such an inquiry would be an excellent thing in many other states beside New York. There is a growing tendency to capitalize the value of a building, for purposes of investment, on the early annual return. In times of housing shortage, or of movements of trade and residence centers, this results in tremendous overcapitalization of the building. If this overcapitalization is used as the basis for a bond issue for public sale, it will often be found that the issue is greater than the actual cost of the structure or the cost for its reproduction on a comparable lot. This is not investment but speculation and calls, if not for public regulation, at least for such regulation as publicity gives. The condition is similar, though the results different, from that which prevails in Miami, for instance, where because a realtor wants a 20-ft.-front store for his office and is willing to lease it at say $60,000 a year, it is immediately assumed that the property has a sales value of $30,000 a front foot, instead of its real value of a twentieth of that when the realtor can no longer sell enough Florida real estate to warrant a $5,000 a month office. Property capitalized value must be figured over many years beyond current demand.

Contracting Criticised

THE PUNGENT characterization of highway contracting by A. R. Hirst in this issue is an interesting companion study to the article by W. J. Barney in *Engineering News-Record*, Sept. 17, 1925, p. 456. Mr. Barney set about telling, with no mincing of words, what the matter with contracting is as perceived by a building contractor. Mr. Hirst excoriates conditions and practices in the next largest field of construction. Neither writer spares his own kind but whales about as freely as an Irishman at Donnybrook fair. The result has been two expositions of contracting as vivid and virile as the literature of the industry contains. And back of the perfervid diction, let it not be overlooked, there is sound observation and constructive thinking. Neither writer is merely "taking a wallop" at contracting—both have a constructive purpose in mind. And their diagnosis of the trouble and their prescription for its remedy are very much the same. Turning particularly to the article by Mr. Hirst in this issue, the charge is that the fundamental fault in contracting public works is that competency is held secondary—that price is the deciding factor in selecting the builder. Mr. Barney asserts that the same thing is true of private building work. Both are undoubtedly right but the conclusion gets us nowhere. The public has to be taught that there are distinctions of class in contracting. This, after all is said, is the contractor's own task. He deserves and should have help from the engineer, the financier and all the other elements of the construction industry, but the burden and the weariness of the work are the contractor's own. He must assume his responsibility. Indeed he has begun slowly to do so in the last few years through association work. And writers like Hirst and Barney put spurs to the activity.

Artificial Subdivision

ENGINEERING COUNCIL, following the lead of the Conference on the Department of Public Works held under its auspices, has come out for such a department with four undersecretaries, one each for engineering, architecture, construction and public domain. The full text of the bill Council will advocate is not yet available so comment on its details would be premature but it is not too early to emphasize, what has many times before been emphasized in these columns, that this subdivision of the functions of a public works department is neither logical nor workable. As a mere matter of political strategy, to put the thing in its basest aspect, this attempt to satisfy the architects and after them the contractors by such a complicated arrangement, is inexcusable. It is true that the contractors demanded their undersecretary with tongue in cheek, merely to make more obvious the unsoundness of conceding the necessity for separate undersecretaries of architecture and engineering, but those formulating the bill apparently could not see the joke. The result is that Congress, if it considers the bill at all, will have the opportunity to listen to numerous witnesses who will demonstrate quite readily that before its first year was over such a new department would be spending most of its time trying to decide just which of its functions were engineering, which architectural, and which constructional. And in another year it would be spending more money unscrambling each item of public works into the three separate parts for the three separate undersecretaries than is spent even in the present jumbled organization of public works. At the recent meeting it was reported that some of the leading organization experts in the country are to prepare detail plans for this four headed

department. They cannot get to work too soon if they wish to overcome the opposition that its very obvious defect invites.

United States Roads

DEFINITION of the 75,000-mile system of United States highways made this year by a special board of engineers appointed by the Secretary of Agriculture has developed its opponents. They charge that too many roads have been picked, that too great a proportion of the roads is in the Middle West and that wrong routes in many instances have been chosen to carry the dignity of the United States marker. The state highway departments, in a word, are running true to form. The essence of democracy still persists. Last month at the Detroit meeting of state highway officials, listening to the secretary of the board on interstate highways tell of the truly remarkable speed and agreement in the work one marveled at what could have happened so to banish contentiousness. It still exists and, one hopes, will never be crushed. The federal board had an onerous and complex labor to carry out and it did remarkably well, all will agree, even its present critics, in carrying it to as full completion as it did. But in the nature of things there can be nothing definite in a system of interstate roads. Industrial development shifts and traffic trends alter as time goes on. Main and secondary road classifications must change accordingly. The board as constituted was not designed to be a continuing body. It has carried through its appointed task and perhaps as a separate agency may well be discharged. But there must, it would seem, be created a continuing body whose duty is revision of the system of United States roads as changes become necessary or advisable. Otherwise these roads will cease to represent in service the idea behind their creation and belittle the dignity of their name.

A Basic Reform in Building

ONCE more the problem of safeguarding the public against defective building is brought to the front. A joint committee of architects and engineers in New York has prepared the draft of a law which is directed against ignorance and incompetence in building and which may also be a protection against the not uncommon attempts to evade and circumvent the safety provisions of building ordinances. Under the proposed law, it would be required of every person undertaking to build that he have his plans prepared and his work supervised by a competent architect or engineer, thereby eliminating irresponsible and amateur building work. To make the architect's or engineer's position in the enterprise definite, the law would require him to render a certificate of safe construction before the building could be put into service. The system proposed would apply to all buildings intended for public use and to all other buildings of more than a defined minimum size. The exceptions include ordinary dwellings and simple buildings, which, as experience shows, can be constructed safely by skilled craftsmen of the building trade without engineering or architectural aid. The proposed law is a noteworthy departure from the conventional view that building safety depends altogether on governmental supervision. Under that view—which in the last analysis compels the municipal government to serve as designing and constructing expert to the owner—responsibility in building has practically disappeared, as shown glaringly by the failure, time after time, of prosecutions for building failures or accidents. Definitely placed responsibility is an obvious essential in any undertaking, but it is effective only when placed upon those who are competent to bear it. This the proposed law, which it is planned to lay before the New York State Legislature, aims to accomplish. It is a measure of much promise, and if the lawmakers can be induced to turn aside from their other preoccupations long enough to recognize its merit the law will establish a precedent and model for building improvement throughout the country. It proposes a basic reform.

The Civil Engineers Progress

THE life-giving touch of flourishing technical activity gave distinct character to the meeting of the American Society of Civil Engineers last week. Besides the sessions of half a dozen of the technical divisions, there were technical committee reports to the number of a dozen or more presented at the general sessions. They gave proof that the plan of initiating group research under the aegis of the society has succeeded admirably. Professor Talbot, who was the main sponsor of the plan, thereby earns another distinction.

But possibly of equal moment in the long perspective of the society's development is the contribution to better management which was made by the activities of the Board of Direction. Constructive changes were made, in organizing for greater efficiency by putting aside routine that has needlessly burdened the board heretofore and by undertaking to meet the need for better correlation of technical division work through a new committee—the Committee on Technical Procedure.

The move toward improved administrative method comes none too soon, for new complications are crowding in. The riot of multiplying technical divisions and simultaneous sessions, whose objectionable features have been felt before this, became most painfully obvious last week, when the second day's proceedings of the meeting broke up into a series of sparsely attended sessions scattered more or less at random over the society building and a number of distant hotel rooms. With this condition existing, with a new division just in process of formation, and still another new division authorized by the Board of Direction—to deal with surveys and mapping—the situation opens a rather appalling prospect of continued and infinite splitting up of activities into perhaps the ultimate atoms of civil engineering. Are the centrifugal tendencies in the profession to increase until the society itself is reduced to a mere form, without substance? Questions of this kind force themselves on notice. Fortunately, the outlook appears entirely hopeful, provided the meetings of the society and its divisions can in time be more suitably ordered. This remains to be done. In the meantime, such other problems as might develop from uncoordinated activity of the sections are likely to be well taken care of in the hands of the board's new committee, which in effect is simply a conference of division heads.

It was a definite step in advance for the board to prepare for handling its business more expeditiously by getting rid of some of its routine activities. Strange as it may seem, this is in fact a matter bearing on the efficiency of the meetings of the society and on the interest of every member. It has been the custom to devote an important part of the annual meeting week

to the sessions of the board, with the result that the members of the society find their meeting limited to three days, or, deducting the traditional excursion, to but two days. Under such an arrangement, an ineffective and congested state of the program is inevitable. Were the board meeting shifted to the preceding week, or were its efficiency increased by elimination of routine, the way would be open for better arrangement of the society's own meeting. It would then not be necessary for a member to limit himself to attending a single one of the divisional meetings and remaining as distant from the other divisions as though he had stayed at home.

But the meeting last week at New York made it clearer than ever that the society is still far from the solution of the technical division problem. Specialists feel that their specialty is important enough to warrant a separate meeting, the multiplication of which in simultaneous sessions deprives the broader minded audience from participation in the society's technical discussions. And yet so far no technical division meeting has proved sufficiently attractive to bring out as many as 100 members.

Harmonizing Steel Stress Requirements

ONE item of work initiated in the course of the meeting of the Civil Engineers is of specially timely character. Joint consideration of unit stresses for structural steel is to be undertaken, under a resolution of the Board of Direction authorizing the appointment of a conference committee of the society and the American Institute of Steel Construction. If the work proves even partly successful, it will clear away a considerable amount of fog. The apparently conflicting recommendations of the two organizations, for 18,000 and 20,000 basic steel stress respectively, have proved decidedly confusing. As a matter of fact, since the two recommendations are coupled to different design assumptions and methods and are evidently intended for different fields of application their conflict is apparent rather than real. While this is probably well understood by the structural specialist, others apparently do not realize it, and there has come into being a fairly extensive feeling of perplexity and wonder over the obvious difference between the two working stresses for the same material, each supported by an authoritative group of engineers. Joint discussion of the subject is certain to show ways of making a comparison of the two reports on a common basis and dealing adequately with the differences then remaining, if any.

Working stresses are not subject to precise determination, and differences of opinion are to be expected; yet the past year's experience has made it fairly obvious that in this particular instance the effect of inharmonious recommendations has been both confusing and harmful. Hence a definite and valuable gain is to be looked for if it proves feasible to clear up those points in which the disagreement is only apparent, and to adjust the remainder.

That it is not always easy to enter upon a harmonizing process in a subject which has several distinct aspects may be judged from the slow progress made in the matter of specifications for steel bridges. The society's committee on this subject was one of the few which rendered no report at last week's meeting. Months ago arrangements were made, after due sanction by both organizations, for a conference committee of the American Railway Engineering Association and the American Society of Civil Engineers, to adjust, if possible, the differences between the steel bridge specifications prepared by their respective committees. Up to date, however, it appears that the conference committee has not yet met. No explanation of the delay was offered at the meeting. In all probability, the inaction is due to nothing more than procrastination and conflict of time schedules; yet it is probably true that if both sides had considered the subject to be of urgent importance to themselves, the conferences would have begun months ago.

Fortunately, in the case of steel working stresses the desire to reach agreement is not hampered by sharp differences of view. An early result may therefore be expected. Its realization will add another item of distinction to those which mark out the meeting just closed.

Reclamation Pessimism

FOLLOWING approved practice of early days in railroading, when investments were scaled down or wiped out by reorganizations, a board of survey of federal reclamation projects recommends that a huge write-off be made from the national investment in these projects. In this, the board is carrying out the proposals of the Fact-Finding Committee which reported on reclamation two years ago, when the projects were in deep gloom because of having gone through a severe agricultural deflation and a price unbalance that for the moment made the irrigation farmer's balance sheet hopelessly bad.

Apparently the board's reasons for the write-off apart from some local consideration and some outright goodwill gifts, are largely founded on the fact that some of the land on the projects turned out to be unproductive. Whatever the reasons, however, they do not lie in unskilled planning and construction; on the contrary, as has been testified time and again by men of every shade of attitude, the planning of the projects was ably done and the construction was as efficient and economical as the best irrigation development anywhere. The present situation, therefore, reflects on the economic soundness of the enterprise somewhat in the same way as the railroad reorganizations, but with this difference, that in the case of the railroads the write-off represented mainly a squeezing out of water, while in the present case it means that the projects are incapable of carrying the capital investment necessary to build them—in other words, they are losing enterprises.

This is significant in its bearing on the continued pleas and demands before Congress that more federal projects be built. Without exceptions, the proposed projects are far less likely to succeed than the old. The old ones represented the choicest opportunities, the most favorable conditions of soil, climate and water. They were developed cheaply, while the proposed projects will cost very much more to develop, and consequently their hay, corn and potatoes will cost more to produce. It seems almost certain, in the light of the history of the present projects, that the new ones also will be subject to a large write-off at some future date despite the most careful planning and the most economical construction. This, in turn, means that their true cost per acre or per farm will be even greater than shown by the cost estimates, and their likelihood of real success still more problematical.

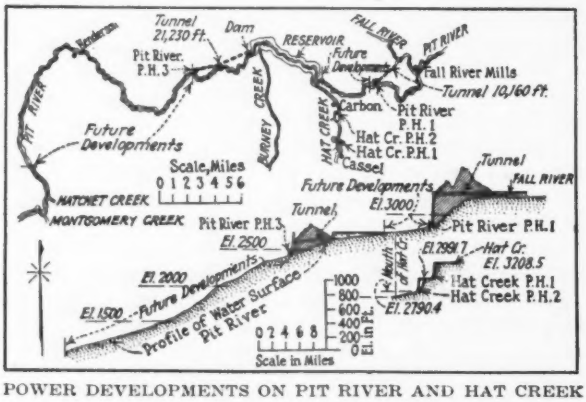
Volcanic Formations Govern Design in Pit River 3 Hydro Development

Dam on Foundations that Required Grouting and Energy-Absorbing Device—Tunnel Lining Reinforced for Full Hydrostatic Pressure—Intake and Manifold Designed for Least Head Loss

By Walter Dreyer
Assistant Engineer, Division of Civil Engineering, Pacific Gas and Electric Co.

THE VOLCANIC formations of the Cascade Mountains, with their continual variation in composition and physical properties impose conditions which largely influence and sometimes entirely govern the design of hydro-electric developments. With the recent completion of the Pit River 3 development, the Pacific Gas and Electric Co. began operation of the fourth plant constructed on this basin, which is the first of the chain of major plants that will use the entire flow of the river. Pioneer work has been done in the design and construction of some of the principal hydraulic structures, notably the dam and the tunnel. It is the purpose, however, of this article to describe some of the advantages and some of the problems arising from the geology of the region and to show how these conditions influenced the general layout and the location and design of the principal structures.

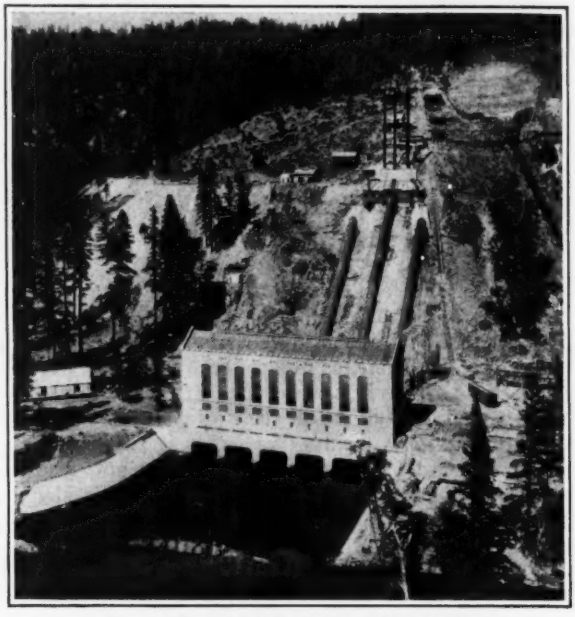
The Pit River Basin—The basin of the Pit River is located in the four northeastern counties of California, Modoc, Lassen, Shasta and Siskiyou. It has a total drainage area of 5,260 sq. miles, but the eastern or upper portion, consisting of 3,400 sq. miles, is semi-arid, and has little value as a source of power. The lower or western portion, however, drains a volcanic region having heavy precipitation ranging from between a minimum of 30 in. at the eastern edge to a maximum of 60 in. per annum. The volcanic formations are very



POWER DEVELOPMENTS ON PIT RIVER AND HAT CREEK

porous so that the winter snows do not run off in the usual manner when the spring thaw occurs. Instead, the water drains vertically downward to the water table from which it is released through large springs in nearly uniform quantities throughout the year. The region is therefore unique in that, unlike other California hydro-electric developments, no storage reservoirs are required.

The power section of the river is 60 miles long and has a total fall of 2,100 ft. It really begins with Fall River, the principal tributary, rather than on Pit River itself. Diverting the remarkably uniform flow of Fall River through a 2-mile tunnel and dropping it into Pit River constitute the uppermost or Pit River 1 development. The remaining Pit River developments are numbered in the order in which they occur downstream.



PIT 3 POWER HOUSE AND PENSTOCKS
Pipe at extreme right takes overflow from concrete surge chamber. Tunnel entrance is behind concrete block anchoring penstocks.

The power section of the river has the natural advantage that the upper portion produces all the water, while the lower portion contains most of the available fall. All of the principal tributaries enter Pit River above the diversion for Pit River 3, so that substantially the same flow is available for the three, or possibly four developments to be built below this point. The average usable flow at the Pit River 3 diversion dam is 2,300 sec.-ft. with a minimum recorded value of 1,700 sec.-ft. and an installation which can use as a maximum 3,000 sec.-ft.

The point of diversion for the Pit 3 development is nine miles below the proposed Pit River 2 power

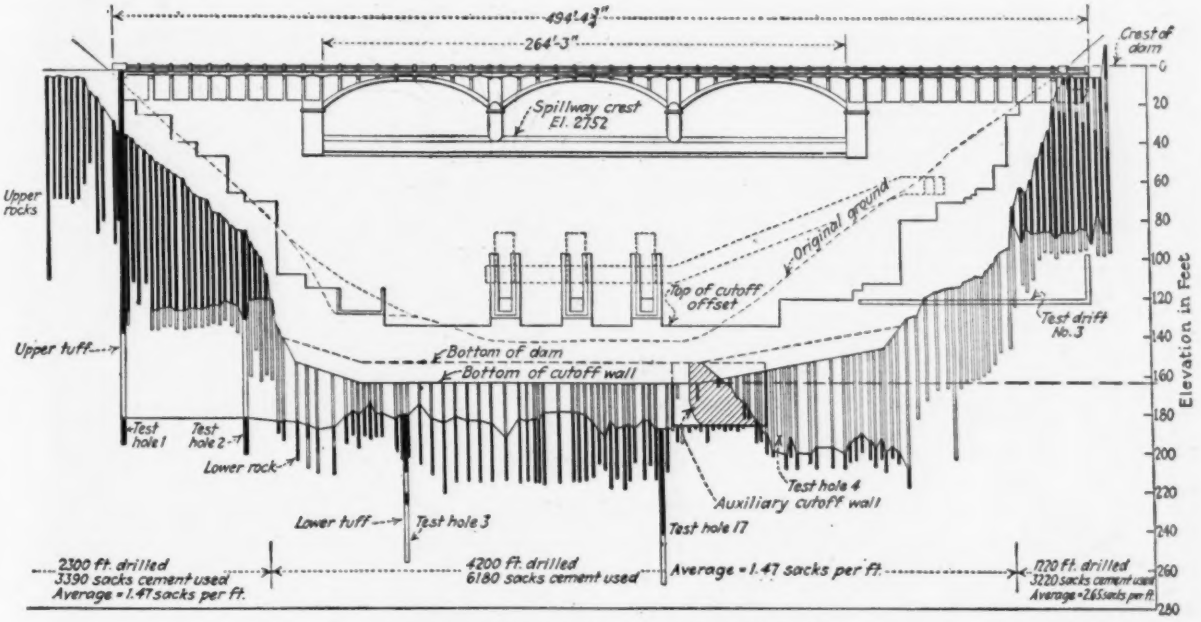
DATA ON PIT RIVER HYDRO-ELECTRIC DEVELOPMENTS

Head	Hat Creek No. 1	Hat Creek No. 2	Pit River No. 1	Pit River No. 3	All Plants
Total	216.8	201.3	454.0	315.0	1,267
Effective	200.0	193.5	419	283.0	1,158.5
Flow, sec.-ft.					
Conduit capacity, sec.-ft.	600	800	1,800	3,000	.....
Average	332	503	1,218	2,305	.....
Installation					
Kva	12,500	12,500	70,000	81,000	306,000
Output					
Peak kw	9,000	10,600	56,300	60,500	241,700
Million kw					
Hours annually	36.8	59.5	315.0	400.7	1,583.1

house. At this point a dam 130 ft. in height diverts the water into a 19-ft. tunnel approximately four miles in length. At its lower end, the tunnel branches into three steel penstock lines each 580 ft. long which continue down a steep hill to the power house located on a flat at the river's edge. The total static head is 315 ft.

Diversion Dam—It is a difficult matter to obtain suitable dam sites in a region containing innumerable lava flows varying in both thickness and composition. The prevailing rock formations in the Pit basin are either basaltic or andesitic lavas, lava agglomerate, or tuff, and these vary within themselves from solid rocks capable of withstanding almost any load, to soft friable material. It is not uncommon to find that what appears to be a solid rockpoint is in reality made up almost entirely of soft material with a capping or veneer of hard basalt or andesite. This characteristic of the tuff show it to have an ultimate strength equivalent to from 50 to 75 tons per square foot, while that of the rock is well above these values. The maximum foundation pressures under the dam are on the order of 8 tons per square foot. Special settlement joints are provided at the junctures of the two types of foundations to allow for possible inequalities in their supporting power.

The dam is of the ogee spillway type, arched in plan on a 500-ft. radius, and 112 ft. in height from foundation to the crest of the spillway. The spillway portion is 267 ft. long, 18 ft. deep and is designed to pass a flood of 70,000 sec.-ft. with the water level at the crest of the non-overflow section. The greatest recorded flood to date is 27,000 sec.-ft. A highway is carried across the dam on a three-span, open-spandrel, concrete arch bridge.



UPSTREAM ELEVATION OF DIVERSION DAM

topography makes the use of the diamond drill absolutely essential in obtaining a proper dam site.

Three miles of river were carefully explored with the diamond drill, with shafts and with horizontal drifts, and consideration was given to eight different sites before the final location was selected. This site consists of four different formations lying in a nearly horizontal position and having a slight dip downstream. The upper formation is termed locally the "upper rocks." These are approximately 200 ft. thick and form the abutments for the dam. These upper rocks are underlain by a thick stratum of firm dense impervious tuff, which is termed the "upper tuff."

Below this formation is another thick stratum of rock, termed the "lower rocks," which is in turn underlain by a second tuff formation termed the "lower tuff," the thickness of which is unknown. The river has cut its way through the upper rocks and is now running on the upper tuff.

It was therefore necessary to construct the dam on two general types of foundation, the center section being founded on tuff and the abutments on the upper rocks. Tests of small laterally unsupported cubes of

A grouted cutoff wall consisting of a single row of holes spaced 3 ft. apart is provided under the customary cutoff wall at the heel of the dam. The cutoff wall was offset so that it projected 5 ft. upstream from the face of the dam in order to permit the drilling and grouting operations to proceed simultaneously with the construction of the dam. Pipes were set in this offset when it was poured and the holes were later drilled through these pipes by means of a diamond drill. The procedure was as follows: First the primary holes at 24-ft. centers were drilled, tested for leakage and grouted. Next secondary holes on 12-ft. centers, halfway between the primary holes, were drilled through these pipes by means of a diamond first tertiary holes (on 6-ft. centers) and, where necessary, the second tertiary holes. In this manner there was a progressive tightening up of the formation which could be checked up by the results of the leakage tests.

The leakage tests were made under a pressure equal to the maximum water surface of the reservoir and the grouting was done under a maximum pressure of 200 lb. per sq.in. The cement required for grouting has averaged about one and one-half sacks per lineal

foot of hole drilled, the rock sections requiring somewhat more than the tuff. The distribution of the cement in these holes is shown in an accompanying drawing.

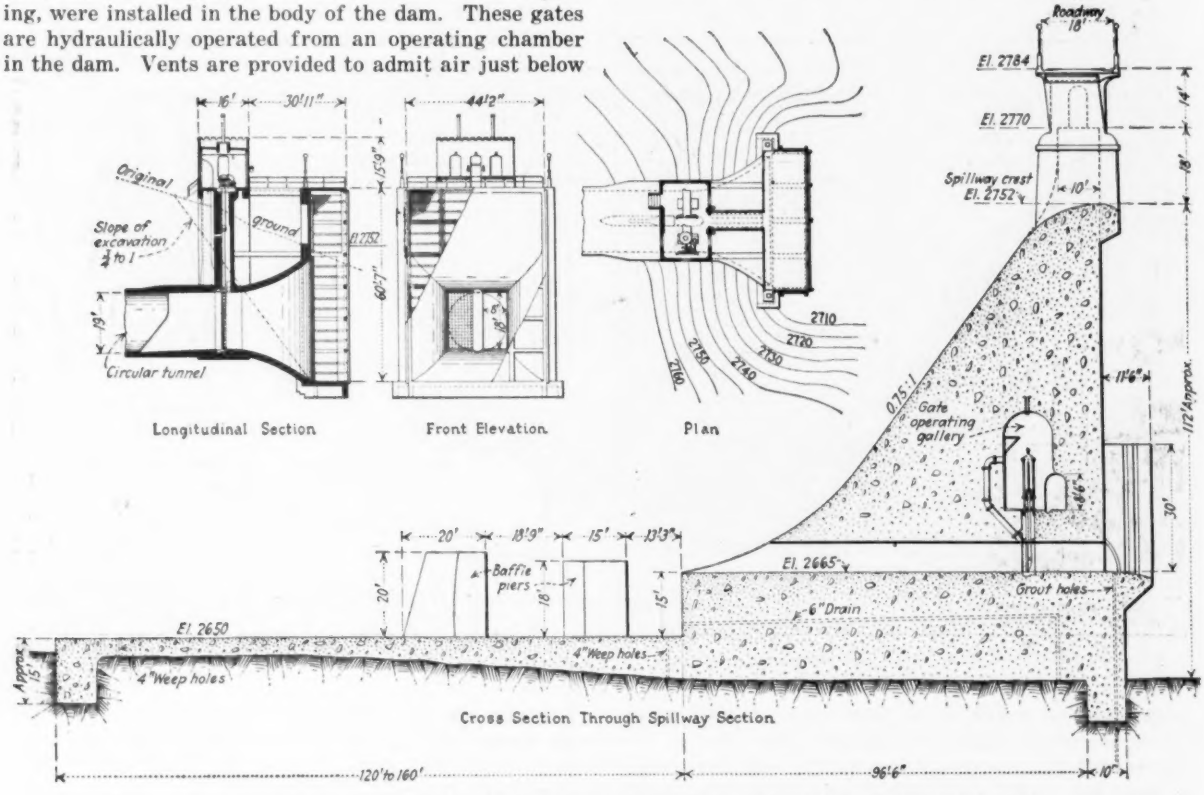
A drainage system is provided for the foundation just downstream from the cutoff wall. A second line of drains in the form of "weep-holes" is provided through the apron at the toe of the dam and also just above the cutoff wall at the downstream end of the apron. The apron was also poured in sections, so that any uplift pressures can quickly be relieved. The dam itself was designed with assumed uplift forces of full static head at the heel reducing to zero at the toe with 50 per cent of the base area assumed as subject to uplift forces.

To permit lowering the water surface of the reservoir, three sluice gates, each with a 7x7-ft. clear opening, were installed in the body of the dam. These gates are hydraulically operated from an operating chamber in the dam. Vents are provided to admit air just below the gate leaf. The gates are designed to operate at a lifting speed of one foot per minute against a force equal to the weight of the gate plus a frictional force equal to the hydrostatic pressure on the gate leaf.

A great deal of study was given to the problem of preventing erosion and scour below the dam. The tuff formation resists in an excellent manner the erosion due to the flow of the stream, but it was considered unsafe to discharge the water over the ogee dam and onto the tuff without first destroying as much of the energy as possible. The use of a pool and the "hydraulic jump" seemed the most logical method, but this could not be adopted at this site owing to the fact that to do so would require cutting through the impervious tuff to the more pervious "lower rocks," and this was deemed inadvisable.

For this reason baffle piers were constructed on the apron, the proportions and arrangement being decided after a series of tests on a 1/30 scale model dam. This model, of exactly the same proportions as the main dam, was built on Rock Creek near the midpoint of the tunnel where a small but permanent diversion structure was required. With but little extra work a concrete basin was built at this point and prior to using the dam in the service for which it was ultimately intended, the dam and the pool below served as an outdoor hydraulic laboratory for experimenting with baffle piers.

Tunnel Intake Structure—The reservoir is not used for storage and the water contained in the top 8 ft. was considered sufficient for regulating purposes, this figure being arrived at on the basis of permitting a shutdown of two days without wasting water. This feature therefore permits weekly as well as daily regulation of the plant.



GENERAL ARRANGEMENT OF INTAKE STRUCTURE AND SECTION OF DIVERSION DAM

The intake to the tunnel which is located on the right bank 300 ft. upstream from the dam is therefore placed at the highest elevation which will permits the regulation required. Since the cost of the Pit 3 development is on the order of $40,000 per foot of head developed, every effort has been taken to see that no unnecessary loss of head occurs and this was kept in mind in the intake design. The trash rack is 2,500 sq.ft. so that the maximum velocity through it is about 1.2 ft. per second. The rack was designed to permit the installation of a rack rake at a later date, should this be found necessary.

Below this rack the structure gradually reduces to the tunnel area where the maximum velocity is about 10½ ft. per second. The shape and generous propor-

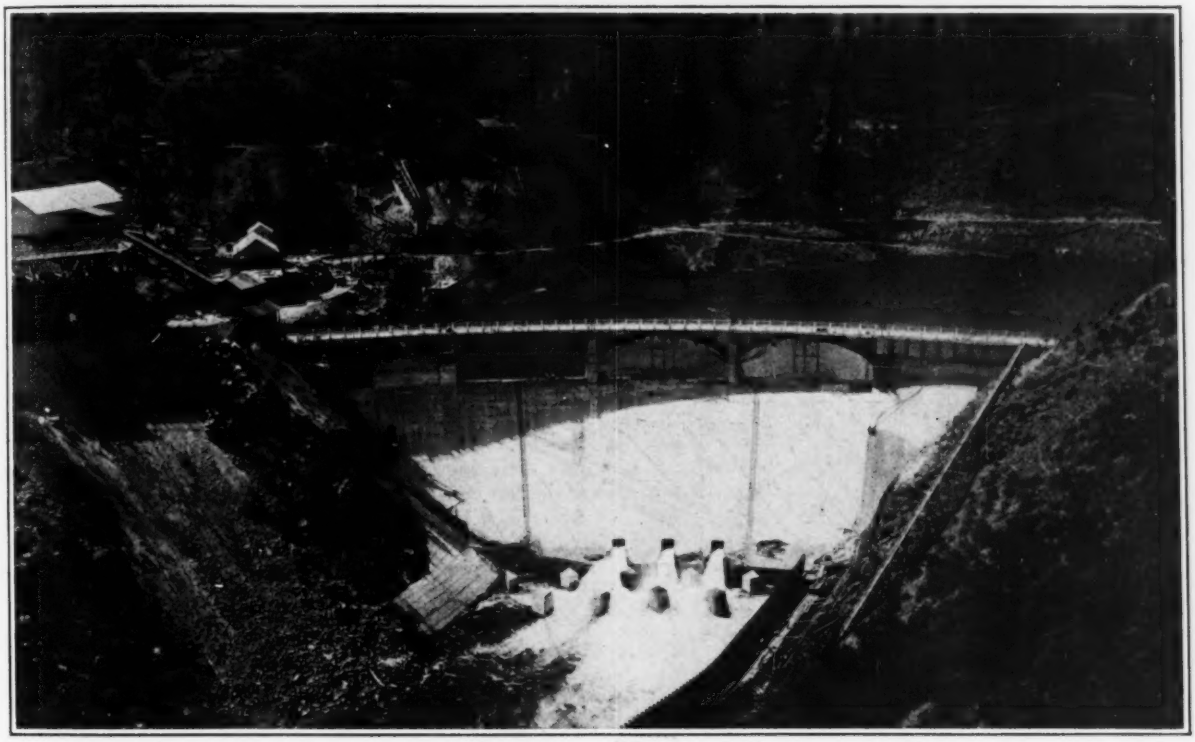
tions of this structure should practically eliminate entrance head losses. Two 8x18-ft. cast-iron slide gates are installed at the entrance to the tunnel proper, these being used purely for emergency gates in the event that it is desired to unwater the tunnel. The lifting mechanism is designed to operate against the weight of the gate plus a frictional force equal to 1/10 of the hydrostatic pressure on the gates, at a lifting speed of one foot per minute.

Tunnel—The pressure tunnel is 21,230 ft. long, concrete lined and circular in section for its entire length, having an inside finished diameter of 19 ft. It has a grade of 3.1 ft. per 1,000, this being determined by the elevation required for regulation at the intake and by the elevation of maximum surge for accelerating conditions at the lower end. The tunnel emerges for a distance of 230 ft. at Rock Creek, 8,700 ft. below the intake. Here a reinforced-concrete trestle carries a 19-ft. reinforced-concrete pipe at tunnel grade, thus giving a continuous conduit of uniform cross-section. The distance from Rock Creek to the power house is 12,300 ft., but an adit located 4,600 ft. below Rock Creek greatly facilitated the driving of the tunnel.

The work of driving a tunnel of this size through the more or less friable and extremely variable lava rocks constituted the principal construction problem. Various methods were attempted and it was often necessary to change the method used due to the constant changing of the formation encountered. These methods were described in *Engineering News-Record*, July 31, 1924, p. 168. The general nature of the tunnel required timbering and since it was impossible to remove either the timbering, lagging or packing before concreting, 98½ per cent of the tunnel was reinforced against full hydrostatic pressure from within, the remaining 1½ per cent being concreted solidly against the country rock.

Since it was impractical to drive a circular tunnel of this size in the lava formations, the lower corners in the reinforced section were backfilled carefully with rock before concrete operations began. In the unreinforced section these corners were poured solid with concrete, this being more economical than changing to the horseshoe type for the very short distance involved. The plant used for concreting the tunnel, which was extremely efficient and highly mechanical, was described in *Engineering News-Record*, July 23, 1925, p. 128.

Surge Chamber—The surge chamber is located about 200 ft. upstream from the lower tunnel portal and is offset in plan about 140 ft. from the center of the tunnel in order to avoid interference with the driving and lining of the tunnel.



PIT 3 DAM AND HEAD-WORKS

Top of intake structure at upper end of tunnel shows at left behind dam. Note baffle piers below dam. During construction water was diverted through flume in right foreground.

Operating requirements for the design of the surge tank were as follows: (1) For acceleration—A uniform increase in flow from zero to 3,000 sec.-ft. in three minutes, (2) For retardation—An instantaneous rejection of 750 sec.-ft. with a uniform retardation of the remaining 2,250 sec.-ft. in two minutes. (3) A maximum surge on acceleration of 60 ft. below the static level corresponding to 32 ft. or 10 per cent of the static head below the level for full operation.

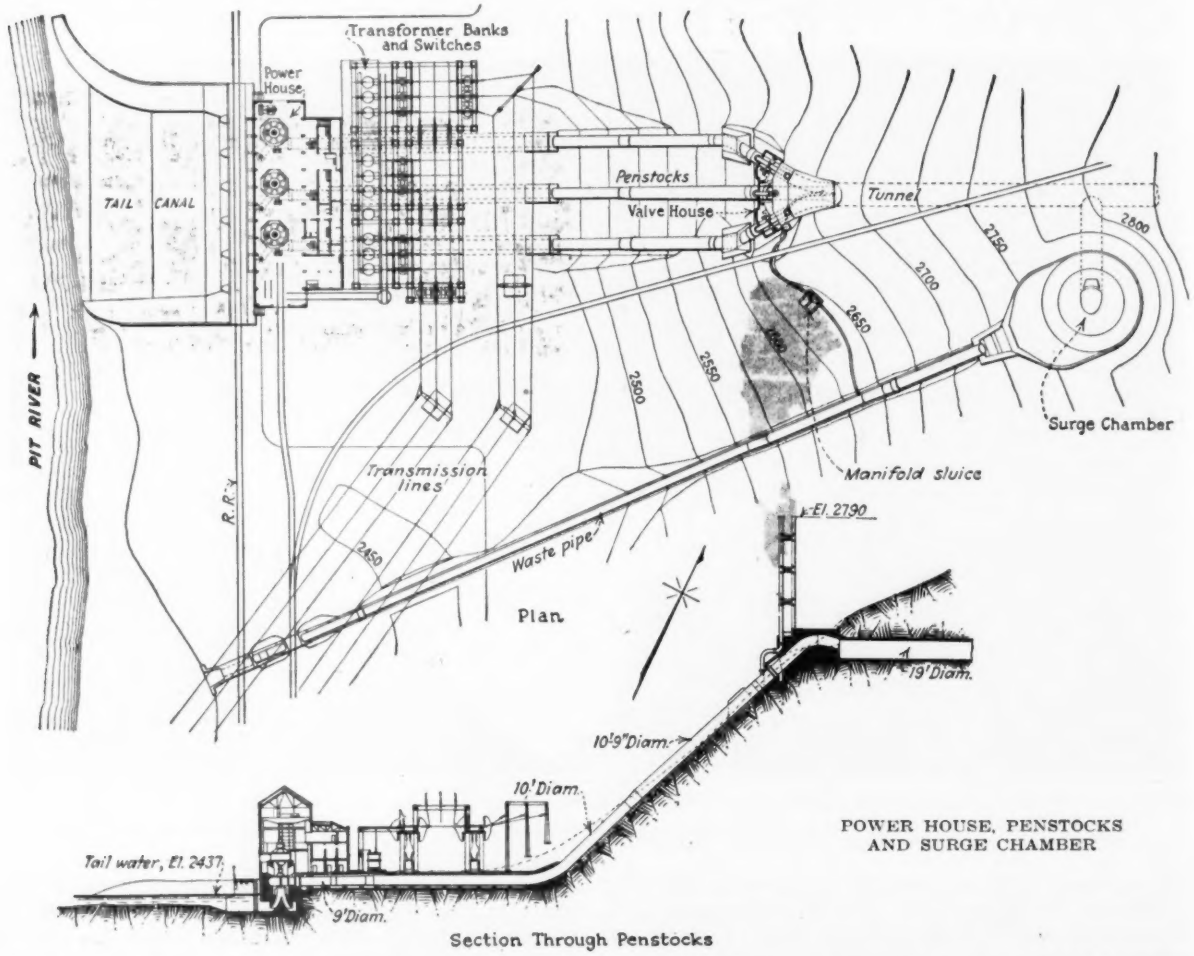
The surge chamber is of the simple type 64 ft. in diameter at the bottom and having ¼:1 side slopes for a height of 60 ft. with a 94-ft. cylindrical portion for the upper 27 ft. The best shape for hydraulic reasons would have been the frustum of a right cone rather than that of an inverted cone, but with the tank located entirely in excavation, this form greatly simplified con-

struction, it being possible to pour the walls directly against the excavation without the use of lagging. The walls were also fully reinforced against the hydrostatic pressure to avoid difficulties due to the shrinkage of the concrete away from the earth.

A spillway is provided, the crest being 3 ft. above the elevation of the overflow crest of the diversion dam. This feature permiits spilling the normal flow of the river over the diversion dam in the event of a long shutdown rather than spilling over the surge tank. A spilling type tank was adopted for two reasons: (1) Due to the fact that the tunnel is reinforced for practically its entire length, any increase in head at the lower end would greatly increase the cost of the tunnel and would have been far more costly than the spillway and spill pipe. (2) The spillway type reduces the amplitude of pressure changes. The water spilling over the crest is carried through a pipe emptying into the river about 200 ft. upstream from the power house.

Penstocks, Manifold and Valves—At its lower end, the tunnel branches into three steel pipe lines 10 ft. 9 in. in diameter and the design of the manifold, which is essentially a large concrete mass containing the three pipe lines was, like that of the intake structure, based on reducing the head loss to a minimum. The three pipes are grouped together as closely as possible, the cross-section at the entrance being that of three 10-ft. 9-in. circles circumscribed by one larger circle. A line connecting the centers of these circles forms an equilateral triangle resting on its base.

The two outer pipe lines at the bottom immediately make a combined horizontal and vertical bend, while the upper or center pipe makes only a vertical bend into the plane of the slope of the hill. These bends are made as sharply as possible to reduce the size of the concrete block. Provision is made for sluicing away any débris which might enter the tunnel with a 24-in. sluice pipe which enters the tunnel just above the penstocks and discharges into the spill pipe some distance below the surge tank.



POWER HOUSE, PENSTOCKS AND SURGE CHAMBER

A butterfly valve is placed in each 10-ft. 9-in. pipe line just below the manifold to permit unwatering any pipe for inspection or repair. These valves are remote-controlled for closing but can be opened only by a push-button located at the valve. A standpipe 3 ft. in diameter is provided on each line to admit air to the line when the valve is closed. These standpipes are constructed on the concrete manifold above the valves and are tied together by means of bracing trusses so that the three pipes, whose arrangement is triangular in plan, become self-supporting against wind loads. Connection is made between the standpipe and the penstock below the valve by short horizontal and vertical runs of pipe.

The penstock lines consist of three triple-riveted, double-butt-strap, steel pipes varying in diameter and

thickness from 10 ft. 9 in. by 7/8 in. at the top to 9 ft. by 3/4 in. at the turbines. They are supported above ground on reinforced-concrete piers, the joint between the pipe and the pier being made with a double layer of 1/8-in. thick Johns-Manville service sheet packing, which provides two graphited rubbing surfaces as the pipe moves due to temperature changes. Kellogg expansion joints with copper-plated inserts are provided in each tangent to relieve temperature stresses, and anchors are provided at each bend in the line.

At the lower end just above the power house, the penstock lines are contained in separate reinforced-concrete tunnels, over which are constructed the bus and switch structures. A butterfly valve 9 ft. in diameter is placed in each line just above the turbine, this valve being used for the ordinary shutdowns of the turbines. These lower valves, like those at the manifold, may be closed from the switchboard floor. They can be opened, however, only from push-button stations at the valve.

Turbines and Generators—The prime movers are three in number and consist of single-runner vertical-shaft Pelton reaction turbines direct-connected to General Electric generators. The turbines are each rated at 33,000 hp. with a flow of 1,050 sec.-ft. under an effective head of 307 ft., having a speed of 225 r.p.m. and a specific speed of 33.2. The generators are 3-phase, 60 cycle, and generate at 11,000 volts. Each machine is rated at 27,000 kva. with a 90 per cent lagging power factor.

The relief valves are each capable of discharging 840 sec.-ft. or 80 per cent of the maximum flow in the penstocks. The draft tube is of the Moody type and in its construction steel liners were used for both the tube and the cone. This type of construction was used to good advantage and the cost of the steel was more than offset by the saving in forms and in expediting the construction. A description of this feature appeared in *Engineering News-Record*, Aug. 13, 1925, p. 264.

Power-House Building—The power house is a steel-frame building with reinforced-concrete walls, floor slabs and roof. The generator room is 45x102 ft. in plan and 62 ft. high from main floor to bottom of roof trusses. Adjoining the generator room is a three-story switch house.

A feature typical of Pacific Gas and Electric Co. installations is the use of two 75-ton cranes instead of one 150-ton crane in the generator room. It is very convenient to have two cranes available during the erection period and in this case each crane could handle any part of the installation except the lifting of the assembled rotor. This lift was accomplished by the two cranes which were connected together by an equalizer beam.

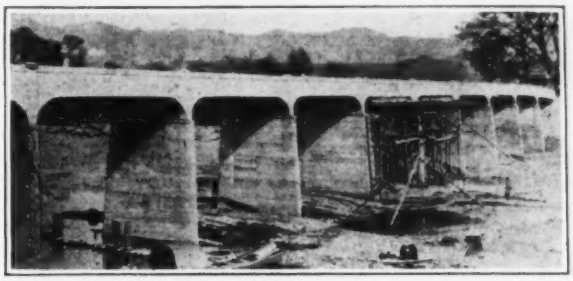
This type of "duo-crane" installation has the further advantage of economy, due to the load being distributed over a greater length of building and thus reducing the size of crane runway girders and columns. For the Pit 3 power house the use of two cranes instead of one during construction resulted in a saving of more than $12,000.

Transmission—It was necessary to construct only 8 miles of new twin-circuit transmission line to connect with the main 202-mile, 220,000-volt Pit River trunk which carries the power of this region to the Vaca-Dixon substation where it is stepped down and fed into the 110,000-volt network of the company.

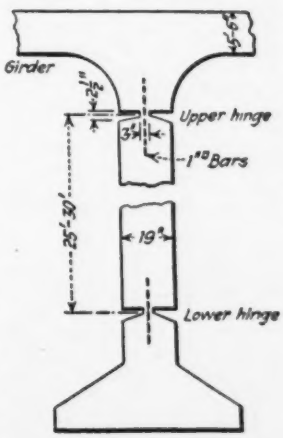
All work on the Pit 3 project was done by company forces. The preliminary investigations and the preparation of plans, specifications and contracts were done by the department of engineering under A. H. Markwart. The construction work was accomplished by the department of electrical construction and operation, under P. M. Downing.

Reinforced-Concrete Continuous Girder Bridge Built in China

A VIEW of an interesting concrete structure just built in China is shown herewith. It represents part of an 11-span continuous girder highway bridge 616 ft. long at Shin Tai Hsien. The interesting structure was designed by Prof. H. A. Patterson, of Peiyang University, Tientsin, and was built by the Yang Tze Development Co. of Shanghai, an organization consisting of Peiyang alumni. F. S. Sun, the company's former construction engineer, now a graduate student at Cornell University, describes the design features of the structure as follows:



CONTINUOUS GIRDER BRIDGE AT SHIN TAI HSIEN, CHINA



ROCKER PIER WITH VIRTUAL HINGES

The two central piers and the girders carried by them are monolithic, forming a rigid frame. All other piers are rocker piers, to allow for temperature expansion of the girders (the daily temperature change produces 1/2-in. movement at either abutment). The piers are 19 in. thick, though 25 to 30 ft. high. To permit rocking movement they are formed with two virtual hinges in each pier, one near the top and one near the bottom. The construction of these hinges in the piers is indicated in the adjoining sketch.

A live-load of 110 lb. was used in proportioning the bridge. The structure is founded on hardpan, which is found at depths of 3 to 15 ft. below minimum low water and is overlain by sand and gravel. In general, the footings were constructed within cofferdams. The total cost of the bridge was about $95,000 (Mex.), of which about $10,000 was spent on bank protection. J. L. Chen was resident engineer for Professor Patterson in the construction of the bridge.

What Is the Matter with Road Contracting?

A Trenchant Review of Conditions and Practices in Contracting Public Road Work, With a Suggestion for Escape

By A. R. Hirst
Chief Engineer, American Vibrolithic Corporation, Des Moines, Iowa

Extract of a paper presented at the Annual Convention, Chicago, Ill., Jan. 11-14, of the American Road Builders' Association.

UNLESS an especial contractor has the cards stacked somewhere in his favor, consistent profits from state, county and federal highway work are so precarious that in the long run one has about the same chance of winning that one has if he plays slot machines for a livelihood.

During the past few years tons of good white paper have been covered with exhortations to highway contractors to get together and instruct themselves and their brethren how to bid so that all jobs would be profitable. Contractors' associations have sprung up, lived, or died—their motto ever being "Make the Contracting Business Profitable." Equipment and material companies, technical magazines, and many engineers and their associations have turned their attention to the problem of eliminating the irresponsible, untrained, unfit, under-equipped, or super-optimistic contractor from the field.

Conditions Not Improving—Brains and money have not been lacking in the effort to improve the conditions under which highway contractors operate. All has been without apparent results. To one who has been quite familiar with the field of pavement contracting for twenty years, it seems that, in 1925, conditions and prices have been relatively worse than at any time in our history.

Certain contractors have always had certain special conditions set up in certain localities, either by the legitimate use of proprietary pavements, or by the especial merit of their work, or by means which we need not discuss. Usually these contractors make a reasonable profit, because they are masters of their own destiny and by one means or another they have eliminated the suicidal knifing of jobs. The ethics of some of these solutions we shall not discuss. It is sufficient to say that every man has a right to safeguard his livelihood and his investment within legal limits. To any one who really knows the pavement field it must be obvious that the only pavement contractors who consistently make a good livelihood, or more, are those who are not thrown into the maelstrom of irresponsible competition on every job on which they bid.

Qualification Easy—On the jobs open to the world chaos has ruled. It has been possible for almost anyone to qualify, even where qualification was ostensibly required. There are still scores of angels with more money than brains, who look at the apparently big paving prices and confuse prices and profits. Any foreman or engineer who has laid a few thousand square yards of pavement feels that he is perfectly qualified to bid and build jobs. He finds an angel; the angel finds some money; some machinery company will sell to anybody; material companies will furnish anybody; some bonding company will bond anybody; almost any municipality will award to anybody who is the low bidder and can furnish a bond. And Presto! We have the Tanlac Engineering & Construction Co.; the Tanlac Co. has a job; and the public at some unknown time will get some kind of a highway improvement finally built.

In case the job is open to the world, not an occasional job, but almost every job is awarded at prices below what even the most optimistic, though sane, contractor could figure as cost, if all the dozens of items which should be figured into cost were really included. Of course, there have been cases, even in 1924 and 1925, where lucky contractors have gotten really profitable contracts as events came out, but these cases are so few and far between that they provide very little brightening to the general picture of great loss, loss, breaking even, or anemic profits.

Estimating an Idle Task—It does not appear advisable that we should all spend any considerable amount of time and energy in formulating and discussing the real fundamentals and the details of actual methods of estimating the expected real cost of a job, which detail must take in every one of dozens of items which together make up cost, when under present conditions the roughest approximations serve every bidding purpose practically as well. "Estimating the job" is easy. The trouble is that good estimating never gets one except by a miracle. Today when an old-timer gets a job he frantically digs over his papers to see just where he made a mistake and dropped out several thousand dollars. Usually he finds it.

I venture the assertion that when the competition was absolutely open to the world in 1925, that in not one out of twenty cases did a pavement job go to a contractor who really estimated with knowledge and intelligence the cost of the job, then added a legitimate profit, and then bid just what his figures showed!

Prices at recent lettings, prices on some recent previous job, the net outcome of which is known, the kind of competition, the time of the year of the letting, the urge or lack of urge to keep men and outfit going, have had a much larger influence on prices bid than valid estimates of cost plus profit. The best estimators are usually the poorest job getters. A real job getter has to be an optimistic Irishman, putting in his bid on a sunshiny day after he has attended the wake of a deadly enemy the night before.

What Are the Causes—What is behind all this? Put in a very few words, the cause of the perennially low stage of public pavement contracting is as follows: Competition open to the world with no price advantage given to the well financed, equipped and manned contracting organization which can, will, and does furnish a good job, built on time without trouble, as compared to the "haywire" organization whose motto is "Muddle through" and whose personnel, financing, equipment, progress and workmanship are alike on the narrowest edge of getting by. Some of the contributing causes for low prices in the highway field are included in the following list:

1. Open competition with widespread advertisement of jobs.
2. No bonus for speed.
3. No bonus for workmanship or quality.
4. No bonus for freedom from trouble in conducting the job.
5. Materials furnished by municipality in many cases, thus reducing financing required.
6. No preference on materials due to too generous lien laws and bonding protection to sellers.
7. Natural desire of machinery companies to sell their goods to anyone.
8. The number of bonding companies competing for business, some of whom will bond anybody. Many of these companies, when in doubt, increase the competition by bringing in new bidders who will bond with them.
9. The gambling tendency of almost all true contractors.
10. Lack of continuous and consistent programs in most areas, leading to a building up of organizations and equipment during the peaks and a wild scramble for the few available jobs during the depressions.
11. General overcrowding of highway contracting field.
12. Lack of really severe qualification of bidders.
13. The almost universal practice of giving any low bidder a job, provided he can furnish a bond.
14. Irresponsible and ignorant-of-cost subcontractors who take details of the work from under-bidding contractors at even lower prices.
15. Sales of motor trucks by some truck companies to anyone "on a shoestring." These shoestring owners, totally ignorant of actual costs, subcontract hauling at far below cost, and give contractors who prey on their ignorance a great advantage over contractors who own their hauling equipment and know what it costs them to own and operate it.
16. The energetic, and usually successful, efforts made by most sellers of pavement materials to bring in low bidders on their especial type of pavement whenever several types are in open competition. In fact, this sustained effort of many large producers of materials to lower pavement prices is one of the most serious phases of the situation.
17. Constant introduction of new firms, new blood, and

new money, and the seeming necessity that most of these new performers get at least one costly lesson before they settle down to normalcy, or pass out.

18. Desire of politically ruled municipalities to make a low price showing on the actual awards, regardless of the final outcome, which can be well covered up.

What Is the Remedy?—There is no remedy reasonably possible, in my humble opinion. The man who can suggest an effective cure for the present evils would deserve from the highway contracting fraternity a reward greater than any man in the construction field ever received.

Deep down below this situation lies the state of mind of our whole people. They have been educated to believe that accepting the low bid and a profitable deal to the public are always the same thing. Public officials cannot long hold their jobs if they award to other than the lowest bidder. They cannot "sell" their people the idea that the contract amount is only one factor of both the total cost and the final cost. All jobs look about the same to the public. Most of them cannot distinguish between a rotten job, a fair job, and an excellent job. They grouch about delays and detours, but they grouch just as much about a few days as about many. The common man argues that with everybody bidding on the same plans and specifications and with a surety bond required, the result must be the same whoever gets the job, and that if the contractor fails to perform, the bonding company must finish the job at the original prices.

There is absolutely no general public conception of the fact that with the same plans and specifications the value of the finished product legally delivered may well vary fifty per cent, if all factors of time, detours, traffic service, and the quality and life of the pavement are taken into account. In the present public opinion "pigs is pigs," a contractor is a contractor, a pavement is a pavement. The contractor who just gets by is just as good as the one who is a world beater in skill, speed, and efficiency.

We will not have a widely different condition in the open field until the general state of the public mind is different—and I doubt whether it can be made to be different. The public gets most of its education on public questions from the politicians and the newspapers and it would be a brave politician or newspaper who would undertake any sustained campaign to raise the apparent cost to the public of public construction enterprises. Few engineers or public officials are brave enough to face the public wrath and the suspicion of grafting which always comes from an award to other than the lowest responsible (Heavens, how that word "responsible" can be stretched!) bidder. If contractors, material or machinery companies, bonding companies, or their associations publicly urge better prices to responsible contractors only, the average man says, "Ha! Of course they would advocate high prices, it means more money in their pockets." Intelligent striving for betterment is stopped at every turn, has been for years and will probably continue to be as long as human nature continues to be the same, and human nature is almost a constant.

Attempts at Improvement—There has been a quite sustained and intelligent effort made in the last two years to improve the situation by providing for the real qualification of bidders, either in advance of the bidding or before an award is made. S. M. Williams, of the Autocar Co., has probably done more than any other one man to promote this much needed reform and a considerable advance is being made. However, on public work, so many exceptions can be made, have to be made, and are made, that the value of apparently rigid qualification is nowhere fully attained. The semi-political atmosphere in which most public work is conducted is not conducive to the exercise of uninfluenced judgment of facts, even where the awarding body has the best intentions.

Little has been said about estimating the job—I am not going to say much. Years ago I was instrumental in having made up and published by the Wisconsin Highway Commission in co-operation with contractors and machinery and material men, a quite adequate cost sheet to be used in estimating the cost of rural concrete road projects. This sheet was much circulated and copied but has about disappeared from the field because it was really quite complete and contractors found that if they filled in all the items with intelligence and then bid the figures the sheet gave them, they never got a job. They ceased to be contractors and became gentlemen of leisure.

I imagine the reason why there is little of this kind of information available now and why contractors' organizations have not devoted themselves to the task of formulating more adequate cost sheets, is because no one can use them. In preparing this paper I did a lot of work preparing cost estimating sheets but the results were so appalling and the answers gotten so at variance with prices bid that my work went into the waste paper basket.

If a contractor is going to stay in the open field of pavement competition, about all he needs to estimate with is the current reports of recent previous awards in the area; a knowledge of who is going to bid; a ouija board; a rabbit's foot, and a good bank account.

When Conditions Will Improve—Some one says, "Stop kidding us and give us something constructive tending to eliminate the present evils." Well, if you must have it! Conditions will be improved when most of the eighteen previously listed causes of the present conditions are partly removed or totally eliminated.

Highway contractors are, many of them, in the game to stay. They have to be, because their all is tied up in it. They play the game because it is the only game they know. They are like the cowboy who got in a crooked poker game in a mining town. When told by his friends that the game was crooked—he replied, in surprise, "Hell, it's the only game in town, isn't it?"

Most of the good contractors have pulled through so far and they will probably continue to pull through until they get the final trimming which is almost inevitable if they bid so as to get jobs in the present market. The Lord does love a contractor, but the Lord also loves those who help themselves. It is up to the real highway contractors to really start something that will help themselves. Just what, requires deep consideration by the wisest heads. Certainly nothing so far started has resulted in anything which has very greatly helped the situation. Obviously, before there can be any general relief many different kinds of people, all factors in the situation, must be educated. Education costs money and takes brains on both ends of the line. Above all, the whole public must be educated. That takes national advertising—which costs real money.

In my opinion, the interests which should be allied to contractors have not co-operated as they should to improve conditions, but on the contrary many of them have materially helped to make them worse. The producers and sellers of highway materials, the manufacturers and dealers in machinery and equipment, the bond and insurance companies, and the banks should all be interested in stabilizing this great industry. They should help in removing from it the unfit and disturbing elements by refusing to accept their business.

In conclusion, it is my impression that there is no collective way out of the present morass which can possibly give immediate results. Small groups of contractors can, in many cases, work out individual solutions for limited areas which will give immediate relief. Any real result can only come with the elimination of irresponsible competition in the area. As long as the competition is open to the world with the awarding body taking into account nothing but the prices bid, there can be no adequate reward for competent service, workmanship, speed and value of product. In my opinion, the really competent and able contractor who stays in the wide open public contracting field is wasting his time and his talents and is unfair to himself and to his dependents.

To reiterate, the answer is not collective. It is individual, and each contractor or group of contractors must work out the answer in their individual area. The sooner good contractors stir themselves to find this individual answer the more money they will have with which to escape the poorhouse, if 1924 and 1925 have left them anything more than their happy dispositions.

One of the very best solutions for competent contractors is to get entirely out of the public contracting game. There is much private contracting on which service, ability, workmanship and speed do count. In fact, public work is about the only building operation which places no added price value on any of these things. I earnestly advise public work contractors seriously to consider transferring their operations to the field of private work, where ability to deliver the goods often counts high, and where the dollars and cents of the apparent first cost is not the sole yard stick of value used by the buyer.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

STREET PARKING, FARGO, N.D.

Fargo, N. D.

COUNTY SEAT OF CASS COUNTY and largest city in North Dakota. Situated about 250 miles northwest of Minneapolis-St. Paul on the Red River of the North just opposite Moorhead, Minn., a town of 7,000 people. It is served by three railroads radiating from it in nine directions. Called the "Gate City," being considered the gateway to the Northwest. Largely a jobbing, trading, distributing and banking center, with farm machinery and other branch houses located here. Founded in 1872 and organized as a city in 1875 when Dakota was still a territory. The Red River was then open to navigation, steamers and barges plying up and down the river as far as Winnipeg. Pop. (state census, 1924) 25,542.

EVERYTHING but dog catcher comprises the duties assigned to the city engineer of Fargo, N. D., one of the wheat belt cities in the Red River Valley. All of the problems of the largest of cities have counterparts here, so Robert T. Jacobsen, who has been city engineer since 1919, interests himself in all sorts of municipal affairs and incidentally indicated as one interest the series of articles of which this is one.

Located in a flat prairie country with gumbo soil that was deposited when the whole valley was Lake Agassiz, underground conditions affecting construction are favorable for trenching though not so good for foundations. Trenches stand well in the dry weather and machine digging is satisfactorily accomplished. Since winter temperatures are extreme and the ground freezes for 5 to 7 ft. deep water pipe and sewers must be buried about 8 ft. to get below frost line. Paradoxically as it may seem the summers are equally intemperate and last August temperatures above 100 were being experienced when the editor visited the valley. The deeply buried water mains help hold down the temperature of the filtered Red River water which serves as city water supply.

With a river coursing through the city, drainage is simple though the local topography back from the banks, which are 20 to 30 ft. high, is decidedly flat. The sewer system is combined and consists largely of vitrified clay pipe obtained from factories located near Red Wing, Minn. No special provision for excluding ground water is made other than the use of cement mortar joints. Since the town is in the center of the great wheat country and is dependent thereon largely for its prosperity, it reflects the ups and downs of agriculture in the Northwest quite readily. In spite of this dependency, the city has enjoyed a steady growth in population, the federal census showing 7,960 in 1900, 14,331 in 1910 and 21,961 in 1920.

For five years the question of annexing the village of North Fargo, just recently an accomplished fact, has been under way, being carried to the supreme court on three different occasions. Like the villages around Chicago, which have grown up adjacent to the big city, North Fargo proudly resisted engulfment. The engineer was thrown into the thick of the fight when protests of the villagers resulted in armed guards preventing city employees from operating water valves and some time had passed before peace was restored.

Fargo has had a commission form of government since 1913, consisting of five commissioners, each in charge of a department or departments, one of whom is the president and chairman of the board. The engineer reports directly to the board or to individual commissioners when requested. All public works construction is handled by the engineer, who is also superintendent of water-works, engineer for the Park Board and member of the Board of Health. For carrying out his various duties he has an assistant city engineer in charge of paving construction and maintenance, an assistant engineer in charge of sewers and water mains, an assistant engineer in charge of sidewalks and an office engineer. During the construction season, which usually lasts from May to November, the organization is enlarged by the addition of inspectors and field parties. For the operation and maintenance of the water-works he has a superintendent of purification in charge of the filtration plant, a chief engineer in charge of the pumping station, an assistant superintendent in charge of maintenance and operation of the distribution system and a manager of the meter department.

Most improvements are paid for by special assessment of the benefited property, the city having issued no bonds for construction of any kind since 1912, when the filtration plant was constructed. The assessment of the cost of special improvements is placed in the hands of a special assessment commission of three members, provided for by statute. This commission spreads the assessment according to the figures certified to it by the engineer.

Fearful that the city engineer might neglect his multitudinous duties, an ordinance passed six years ago prevents him from engaging in outside professional work.

The real reason for the passage of this ordinance was that there was a strong feeling at the time that it would be for the best interests of the city if the engineer were required to devote his entire time to the city's affairs. The present engineer can see the justice in this but feels that if he were permitted to engage in the practice of his profession outside of the city, the city would ultimately also gain somewhat from his additional experiences. Possibly the authors of this ordinance felt that the engineer should be able to eke out a comfortable living for himself and family on the $3,600 presented to him annually by the city.

Water—Perhaps the water-works is the most vital problem with which the engineer has to deal. Reservoir sites are few and far between in the flat country and the summer flow of the river, particularly during the past season, has been scarcely enough for the city's use. Fargo, however, is one of the first cities in the valley to build a plant, designed by Frank L. Anders. Enlarge-

ment of the clear well and sedimentation basins and needed changes in the original plant, which operation disclosed as necessary, have recently been made at a cost of $70,000. The new work was constructed and cut in with the old plant without interfering with operation though Mr. Jacobsen put in some sleepless nights.

The water-works operates under a special ordinance with a separate department which keeps its funds intact. Specified amounts are set aside each year for depreciation. This arrangement has enabled the department to carry on a $150,000 construction program during the past four years and still leave a $75,000 balance on hand. Water is sold at 15c. per 1,000 gal., the average cost being 11.5c. per 1,000 gal. divided up as follows: Pumping, 5.46c.; filtration, 3.06c.; mains and hydrants 1.25c.; meters 0.80c.; and depreciation, 0.96c.

The river water is turbid, ranging from 15 to 350 r.p.m. but a clear effluent is delivered with a bacterial count of 2 to 4 per c.c. The typhoid record attesting the real efficiency of the plant shows but three deaths in the city since the filtration plant was placed in operation in 1912, and in each of these cases there is a question whether or not it originated in the city.

Garbage—Unlike most cities of its size, Fargo has looked before finally leaping into garbage disposal. While a $100,000 bond issue was authorized by the people for an incinerator, careful analysis of the bids following the agitation were made. It was then decided to continue an open-dump method of disposal until further advances in the art had been made. Garbage is collected by a contractor six times per week in the business district and twice per week in the residence district. In winter (November to May) the frequency is three and one per week respectively. Dumps are located one-half mile from the nearest residence and about three miles from the center of town.

Street cleaning is handled quite satisfactorily with two motor-driven flushers equipped with 1,200-gal. tanks, which are also used for sprinkling, supplemented by white wings in the downtown business area. Flushing is done at night, all of the paved streets in the city being flushed twice each week during the summer.

Snow removal is handled with a 10-ton crawler tractor and a specially constructed snow plow and blade grader. In the business area snow is emptied into manholes along the line of larger sewers.

Fargo has over 616,000 sq.yd. of paving, equivalent to about 39 miles of 30-ft. width surface. This represents about 40 per cent of the street mileage in the city. The principal materials in use for paving are bitulithic, bituminous concrete, vitrified brick, creosoted wood block and concrete. More than 50 per cent of the total paving yardage is bitulithic. Recent paving construction has embodied the use of steel reinforcing in the concrete foundation for all types of paving and this has been found fairly satisfactory to assist in withstanding the peculiar behavior of the subgrade. Suitable aggregates in the shape of sand, gravel or crushed rock are not available within a 50-mile radius, crushed rock being shipped over 200 miles into Fargo from Duluth.

Fargo is perhaps one of a very few cities in the United States that can boast of having a comprehensive zoning ordinance, which has to date not been attacked in the courts. After attempts had been made for nearly ten years to control the use of property within the city, a zoning ordinance was finally prepared and passed in April of this year. The engineer collected considerable data used in the preparation of this ordinance and assisted in putting it before the people to secure its passage.

Paving Mixer Operates Efficiently on Curb Construction

IN BUILDING curb and base for asphalt paving in Omaha, a paving mixer has been operated very effectively to put in curb separately from the base.

POURING SEPARATE CURB WITH 21-E PAVING MIXER

This curb runs 114 cu.ft., or about 4⅓ cu.yd., per 100 lineal feet for the combination type and a 21 E paver puts in 1,500 to 2,300 ft. a day with dry batch haulage in trucks. Two pavers both alike are used on the paving operation, one laying base all the time and one working on curb part of the time—until it begins to run too far ahead—and then coming back to help build base. For base one cement and five gravel-sand aggregate are used with generally a five-sack batch. The curb concrete consists of 6 sacks of cement to 21 cu.ft. of gravel. Heavy trucks with two or three batch compartments feed the mixer. A Fresno prepares the trench for the curb. Levels are got from engineers stakes set 4 ft. back. Then come the form setters and the paver. When pouring curb the paver moves along as it spills the bath and the curb is finished close behind. The work described is being carried on by George Parks Construction Co., of Omaha, Neb.

Water-Works and Sewerage Systems in Middle West Cities

The accompanying table is based on information recently collected by George W. Putnam, chief sanitary engineer, Missouri State Board of Health, in his campaign to activate the smaller cities:

State	Above 2,500 Pop.			From 1,000 to 2,000 Pop.			Below 1,000 Pop.		
	Tot.	Water	Sewers	Tot.	Water	Sewers	Tot.	Water	Sewer
Iowa.....	81	81	79	129	125	109	703	283	103
Kansas...	62	62	59	82	78	48	381	103	17
Missouri.	65	65	57	118	82	40	530	42	9
Illinois...	172	161	...	229	149	...	711	146	...

American Society Has Seven Divisional Meetings

Technical Discussions of Annual Meeting Held in Two Buildings Scattered Through Seven Technical Divisions—One Afternoon Devoted to Committee Reports

TECHNICAL matters at the annual meeting of the American Society of Civil Engineers were discussed on the afternoon of Jan. 20, devoted to committee reports, and all day Jan. 21, devoted to six separate meetings of the technical divisions noted below. In addition, the City Planning Division held its usual quarterly meeting.

Structural Division

According to its program, the Structural Division intended to have two papers read and then discuss seven of the committee reports made to the society on the previous day. The presentation of the papers and discussion of business matters of the division took so much time, however, that only one brief item of discussion on committee reports was possible, this being a review by Prof. F. A. Dufour of highway bridge impact data.

D. B. Steinman described the several novel design features of the Florianopolis suspension bridge, in Brazil, completed during the past year. William G. Grove, of the American Bridge Co., told of the ingenious method of erecting the suspension chains and stiffening trusses of the structure. The bridge is a suspension structure with straight backstays, main span 1,113 ft. 9 in., for highway service, and connects the island on which Florianopolis is situated with the mainland of the state of Santa Catharina, Brazil. Its suspension members are chains of high-strength heat-treated carbon-steel eyebars, minimum yield-point 75,000 lb. per square inch. The tower posts have rocker base. The stiffening trusses depart from the conventional parallel-chord form, their top chords sloping upwards to meet the cables at about the third point, and in the middle third the cable forms the top-chord member of the truss. Saving of metal and increase in stiffness of the structure are secured by this arrangement, as set forth by the designer in *Engineering News-Record* of Nov. 13, 1924, p. 778. Mr. Steinman's paper discussed in some detail the several novelties of the design and their advantages, but pointed out that the same or similar stiffening truss arrangement has been embodied in a number of prior designs, going back some 30 years.

In full-size tests, specimen eyebars showed an average yield-point of 85,000 (range 78,000 to 96,000), an average ultimate strength of 123,000 (range 114,600 to 137,900), and an average elongation of 6.8 per cent in 18 ft.

Erection was carried out by setting the approach viaducts and main towers (these being stayed by the approach spans, in view of their rocker-base support), and then stringing over one of the two sets of cable saddles a group of 24 steel ropes of 1 in. diameter as support for the members of the eyebar chain until connected and swung. By means of a trolley, clamps and chain hoists were attached to this temporary rope cable at the pin points of the eyebar chain, and alternate groups of eyebars, with their end pins, were lifted from barges in the straits below and hung in position on the chain hoists. The eyebars of the omitted panels were then similarly lifted and were threaded over the pins already in place. This system of procedure was possible because each chain was composed throughout of four eyebars, in alternating inner and outer pairs. Threading the eyebars on the pins was facilitated by a novel method of shaping the holes, the rear half of the hole being slightly larger in diameter than the forward or pulling half. When the one chain was thus all placed, and lowered to bearing on the pins by manipulating the individual chain hoists, it was released from the temporary rope cable; the latter was then shifted rope by rope to the other pair of saddles and the other chain erected like the first. The actual lifting and connecting of the two eyebar chains occupied only three weeks (the first two weeks and the second one week), and the entire procedure of chain erection, including the temporary work, occupied only two months' total time.

The paper was discussed by L. S. Moisseiff, Spencer Miller, Jonathan Jones, and others. The advantage of the rocker towers was questioned by both Mr. Moisseiff and Mr. Jones. In some other bridge designs it has been found that the cost of a cylindrical roller base, compared with the fixed base of a tower designed to yield to the cable movement by its flexibility, exceeded the value of metal saved in the tower. In the Florianopolis bridge a cylindrical roller bearing was not used, and the rocker base consists merely of upper and lower castings with line bearing. With such a design, Mr. Jones suggested, the eccentricity of load on the caisson may become a factor in the design. The calculated economy of tower design further depends on the relative unit stresses assigned to the rocker tower and to the various sections of a fixed base tower.

D. F. Holtman reviewed in comprehensive manner the factors of timber quality and its progressive change as forest utilization extends. He emphasized the importance of the problem of economy and conservation of timber, of rational grading of timber and proper assignment of working stresses, on the one hand, and such appreciation of timber values as will stimulate most efficient forest exploitation.

Highway Division

At the highway division sessions, attended variously by 15 to 30 members, papers elicited principal discussion on bypass roads and new designs in concrete pavement. Following the paper of W. W. Crosby, location engineer of the Pennsylvania State Highway Department, on "Economic and Engineering Problems of Highway Location," the point was stressed by several speakers that bypass roads are the next important consideration of highway departments, particularly the older ones. It was stated that the harmonizing of the wishes of the commercial population of cities or towns to be bypassed and highway builders was a problem that required the most careful handling and one for whose solution there could be no general formula. The discussion on Colonel Crosby's paper was opened by

Charles B. Breed, professor of railway and highway engineering, Massachusetts Institute of Technology. "Bituminous Treatment of Earth-Type Roads," read by W. B. Catchings, was a description of the development and wide use of sand-asphalt and surface-treated highways in North Carolina with which that state has been so successful. Mr. Catchings is the state construction engineer of North Carolina.

At the afternoon session principal interest centered about the discussion by H. Eltinge Breed, consulting highway engineer, and Prof. E. G. Hooper, assistant professor of civil engineering at New York University, of a triangular slab type of concrete road for heavy-fill or viaduct construction. This proposed type was brought into discussion following Mr. Breed's paper on "Recent Developments in Concrete Pavement Design." The triangular slab design has as an underlying theory the ease of replacement in event of bad cracks through uneven settlement. In effect the slabs are (though they do not have to be) equilateral triangles of a 10-ft. altitude, designed as simple beams and supported at the corners by timber cushion blocks supported on piling, giving a drop-panel column effect. Slabs would be reinforced by bars bent into triangles so that the sides of reinforcing triangles would parallel the slab sides, with mesh at the center where the triangles would have to be so small as to be more or less ineffective and difficult of placement.

R. W. Crum read A. T. Goldbeck's discussion of Mr. Breed's paper, the latter being in Montreal attending a session of the National Crushed Stone Association, with which Mr. Goldbeck is now associated as director of the engineering bureau. Mr. Crum explained a new design in the thickened-edge slab in use in Iowa, wherein the slab thickness is added to the edge at the top of the pavement to make, in effect, a curb and gutter section. Thus, surface water that otherwise might start disintegration at the shoulder is carried on the pavement itself.

The afternoon session closed by the showing of two Bureau of Public Roads films. That showing the construction of the 40-mile federal-aid project across the Great Salt Desert in Utah was highly interesting.

Construction Division

Organization of the Construction Division authorized at the Montreal meeting last October by the Board of Direction was completed on Friday by adopting a constitution and electing an executive committee of five members. This committee for the first year is composed of J. P. H. Perry, vice-president, Turner Construction Co., New York; A. S. Downey, engineer and contractor, A. W. Quist Co., Seattle, Wash.; A. C. Everham, western contract manager, Raymond Concrete Pile Co., Kansas City, Mo.; H. W. Latta, engineer and contractor, Latta & Roberts, Philadelphia, Pa., and W. J. Barney, Barney-Ahlers Construction Corp., New York. These men were elected two for one year, two for two years and one for three years; succeeding elections will be for three years. The committee elects its own officers.

The meeting of the division was opened by A. P. Greensfelder, secretary, Fruin-Colnon Contracting Co., St. Louis, with a statement of the problems and possibilities of the construction division which was an elaboration of his announcement in *Engineering News-Record*, Dec. 24, 1925, p. 1042. It was stated that about 1,100 members of the society classify themselves as construction engineers and that of this number about 350 had signed up as members of the construction division. Besides this membership by virtue of membership in the society the division constitution provides for the enrollment of division affiliates with all privileges except the right to vote. Affiliates will pay dues but division members enrolled from members of the society will pay no other than their regular membership dues. In working out the constitution general discussion on the possibilities and purposes of the division indicated several directions of activity deserving of attention but no agreement of thought.

About 20 members attended the organization session. In the afternoon the attendance had increased to over a hundred, who listened to talks by E. J. Mehren on the possibilities and objects of the division, by W. J. Barney on winter construction economics and by J. C. Meem on subway construction. Mr. Mehren stressed the thought that the purpose of the division should be primarily to develop the technique of construction. The need of research to this end was emphasized. Above all it was urged that the constructor had a place to fill in the unity of construction and that the division should purposefully proceed to determine its objections and to chart out the course to them. The talks by Mr. Barney and Mr. Meem were brief presentations of pictures of winter building operations and of subway construction.

Power Division

The three sessions of the Power Division were devoted to certain features of three power developments, the morning session to the civil engineering features of the Kearny Power Station, by R. von Fabrice, and one on similar features of the Hell Gate Power Station by E. M. Van Norden, and the afternoon session to the Soft Maple Dam, by W. P. Creager.

It would be hard to find two steam-electric power stations with as many differences in their civil engineering features as the Hell Gate and Kearny stations, one built on piles in soft mud on a wide tidal flat where these were no unusual restrictions as to layout, and the other on a rocky shore of the East River at New York City, where streets and high real estate values made economy of space a prime requisite. The contrast brought out many points of interest and the discussion was active. One point of special interest was the use of 18,000 lb. per sq.in. as a unit stress in steel in the Kearny station instead of 16,000 lb., with a saving of about 12 per cent in the cost of steel. George A. Orrok, in the discussion, said that he doubted the economy of using high unit stresses as he had never seen a station built that was not later called upon to carry much heavier load than figured in the original design.

Discussion of the Terminal Dam of the Soft Maple development at the afternoon session was even more active than the morning discussion. The dam is a sand-fill structure, about 140 ft. high, with no core wall. The sand was sluiced into place and an attempt was made to make a core wall of fine material at the center of the dam, but, according to Mr. Creager, the attempt was not very successful, as the amount of fine material was limited and superficial evidence that fine material accumulated at the center of the dam as the material was sluiced in was found to be deceptive.

The dam abuts against hills of glacial material, and

after the pond was filled numerous springs developed along the base of the hills below the dam as well as a large amount of seepage through the dam. During the early days a certain amount of sloughing occurred on the downstream face of the dam and its general condition caused no small amount of anxiety. However, since then there has been a fairly regular diminution in flow and no further trouble is expected. The amount of seepage through the dam and through the adjoining hills seems to indicate that the dam is more impervious than the hills. Records of the amount of seepage and of the level of saturation in the dam are being kept and should provide a valuable record. Discussion centered upon the safe amount of flow through such a structure and upon the methods of keeping down the amount of saturation.

Waterways Division

Some 45 or 50 attended the session of the Waterways Division, which was held in the morning. In the afternoon the division made an inspection trip to dredges and drills at work in New York Harbor under the direction of the United States Corps of Engineers. Two papers were read and discussed. The first, "The Deeper Hudson," by Col. John R. Slattery, recently of the Corps of Engineers, now deputy chief engineer of the Board of Transportation of the city of New York, explained the procedure of investigation by which the U. S. Engineer Department analyzed the prospective business of the Hudson River to a proposed port at Albany, as a result of which recommendations were made and appropriations have been granted for the deeping of the Hudson to 27 ft. to take care of ocean vessels at a port to be built at Albany by local authorities. The general conclusions were that the prospective business in an area contributory to the Port of Albany warranted development to take care of ocean-going vessels and that the building of the harbor and the development of the channel were well within engineering possibilities at a cost whose amortization would be less than the benefits accruing therefrom. Further details of the investigation were given by E. P. Goodrich, engineer of the new Port of Albany.

The second paper was by Royal G. Finch, state engineer and surveyor of New York, entitled "The Operation of the New York Barge Canal." Mr. Finch recited the history of the barge canal and explained why, in his opinion, it is not now carrying as much as some thought it should. The canal is supposed to have a capacity of 20,000,000 tons annually, and in the year 1925 there was carried a total of 2,330,000 tons, which is 15 per cent above the previous year and 100 per cent above 1918. This is an orderly progress and in Mr. Finch's opinion it does not warrant the discouraged attitude toward the canal that is prevalent. He says it is not carrying more because of a lack of boats. There were 5,000 boats of the small size in 1870. There are now 800 boats and that number has not increased in the last year or two, although the average size of each boat has increased. People will not build new boats now for fear of the prospective ship canal either across New York State or down the St. Lawrence, both of which are being very strenuously advocated. He stated that in spite of contrary reports there was from 10 to 10½ ft. clear depth all through the canal. While the canal is supposed to have a 12-ft. clear depth, the maintenance charges to keep it at that depth are so great that it is not possible to assure anything more than 10½. Even on that draft there are barges now moving down the canal with 1,000 to 1,500 tons capacity, some going clear through from New York to Detroit, and fleets of barges with 1 tug aggregating 2,000 tons, running between Buffalo and the Hudson.

Frederick Fay called attention to the possible boom which will come to the Barge Canal when the Welland Canal is opened, thus permitting large lake steamers to come as far as Oswego, whence they may go down the canal to New York. Maurice Williams, who has been specializing in traffic in the Hudson River and canal district, stated that the traffic growth on the canal has been adequate, about 12 per cent a year and it should reach its normal capacity about 1942. Maj.-Gen. Harry Taylor, Chief of Engineers, U. S. Army, remarked on the peculiar conditions of transportation which make the Great Lakes ship freight so cheap. He said that the ordinary commenter on this fact fails to recognize that such low rates are not applicable in all waterway transportation nor are they applicable to general commodity service on the Great Lakes.

Sanitary Engineering Division

In line with the policy previously followed by this division, a single major subject was considered at meetings attended by from 75 to 100. Seven papers on garbage disposal were presented. Between the two sessions the members joined with the New York Section of the American Water Works Association in a luncheon meeting. In addition the Division had a dinner on Tuesday night, after which T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission, gave a moving-picture talk on the activated-sludge plant at Milwaukee, which was put in operation the middle of 1925. From Mr. Hatton's remarks it appears that considerable trouble has been experienced in getting this huge plant into working order, particularly with the dewatering plant.

The opening paper on garbage disposal at the Thursday meeting was a general review of the whole subject by Samuel A. Greeley, Chicago. Among a number of important points brought out by Mr. Greeley was the relatively low capital outlay required for garbage collection and disposal compared with that for sewage collection and disposal, and the relatively high operating expenses for garbage as compared with sewage disposal.

There were two papers on garbage disposal by feeding to hogs: One by E. D. Rich, director, Bureau of Engineering, Michigan Department of Health, which described the municipal piggery owned and operated for some ten years past by Lansing, Mich., and another by Willis T. Knowlton, sanitary engineer of the city of Los Angeles, devoted to the hog-feeding plant of the contractor for the disposal of Los Angeles garbage (see lengthy article in *Engineering News-Record*, Aug. 26, 1925, p. 208). The Beccarri system of garbage disposal by fermentation at Scarsdale, N. Y., which has been in operation for some two years, was described by Arthur Boniface, village engineer of Scarsdale. Although the storage detention period in the cells has been materially extended over the 30 or 40 days originally estimated as necessary, the material drawn from the cells has been found to have a 45 per cent moisture content and to be in no condition for grinding. Separate drying facilities have been provided and "cones" have been inserted in the cells, resting on the bottom racks,

to facilitate air circulation. It is now proposed to blow in air to give still further circulation and drying.

The old and new refuse destructors at Toronto, Ont., the new one put in operation in 1925, were described by James A. Burnett, engineer of the Department of Street Cleaning. The garbage reduction plant at Detroit, Mich., thought to be the largest single garbage disposal plant of any type in the world, was described by R. K. Davis, general manager, Detroit Reduction Co. John V. Lewis, superintendent waste disposal, Rochester, N. Y., described the Cobwell system of garbage reduction installed and operated by that city.

The general discussion on garbage disposal was opened by H. P. Eddy, consulting engineer, Boston, who said that it is comparatively easy to get capital to build garbage disposal works, but the weakest point in the service is to obtain efficiency in operation—exactly the same as in sewage treatment. Rochester illustrates this point as to garbage disposal, it having let its plant almost go to ruin through lack of operation until finally Mr. Lewis, the author of one of the papers noted above, was put in charge. Kenneth Allen, sanitary engineer, Board of Estimate and Apportionment, New York City, stated that during 1925 the three boroughs of New York City, under the commissioner of street cleaning, sent nearly 2,000,000 cu.yd. of garbage to sea for disposal and over 25,000 cu.yd. to 14 incinerators.

Before taking up the garbage symposium a progress report by the Committee on Filter Sands was submitted by W. Stanley, Chicago, as chairman of the committee. The committee proposes to give particular attention to coarse filtering media for sewage filters and has outlined a general program for that purpose. Mr. Stanley said that as a rule some local material is used for coarse filter media—as granite at Fitchburg, Mass., trap rock in New Jersey, and either limestone or slag in the Middle West. H. P. Eddy, Boston, stated that the city of Akron, Ohio, will soon require 225,000 cu.yd. of filtering material for its new sewage-works and that the estimated difference in cost between slag and limestone will run somewhere between $100,000 and $200,000. The slag used in the old sewage filters at Akron has cemented badly in spots, making a quite good concrete. The reason for this is not wholly apparent and questions relating to both slag and limestone emphasize the need for investigations of sewage filter media.

Reports of Technical Committees

Nearly all of the society's technical committees rendered reports. A number of these were final reports, chief among them those on stresses in structural steel and on impact in highway bridges. The reports on standard construction contracts and on arbitration were final in the sense that they represented the closing up of essentially integral stages of the work. The other committee reports included a number of unusually important and informing progress reports.

Stresses in Structural Steel—Prof. F. O. Dufour, reporting for the majority of the committee on Stresses in Structural Steel, said that the committee maintained the views and conclusions expressed in its report rendered a year ago, in which a basic working stress of 20,000 lb. per sq.in. was recommended for general use in building work (under certain important precautionary provisos). The discussion during the past year by members of the society did not contribute new facts or supply a basis for any change of views. A minority report by 4 of the 12 members continued to oppose the 20,000-lb. provision.

Impact in Highway Bridges—Prof. A. H. Fuller reported that the committee investigation of impact in the floors of highway bridges is complete so far as it seems advisable to carry it at the present time, and that no means are at hand for securing loadings heavy enough to permit making satisfactory impact measurements on truss members, for which reason the committee renders a final report and considers its work at an end.

Impact values for floors were determined in a series of measurements on bridges in the vicinity of Iowa State College, and these subsequently were correlated with measurements of the impact blow of truck wheels by the U. S. Bureau of Public Roads and by the Illinois Division of Highways. The results show small impact at all speeds from 8 to 14 miles per hour on a smooth concrete floor, but very large values of impact when the vehicle ran over obstructions 1 in. to 2 in. high. In the latter case, at 10 to 14-mile speed, the impact increment of stress in floor members reached and even exceeded 300 per cent for ratios of unsprung to total weight of vehicle exceeding 30 per cent, and ran even higher for larger values of this ratio. By a correlation of these stress tests with the proper cylinder impact tests on road pavements, in a manner not made clear in the report, formulas were deduced expressing separately the "dynamic force" or effective equivalent of blow of the wheel on the bridge deck, and the ratio between this dynamic force and the impact stress.

Prof. Dufour discussing this report later in the meeting of the Structural Division, brought out that his own tests on Illinois bridges ten or twelve years ago showed very high values of impact in bridge trusses under timber floors, without artificial obstructions, while impact under concrete floors was almost imperceptibly small.

Concrete Arches—A brief outline of the test work on concrete arches was given by the committee chairman, Prof. Clyde T. Morris. The work so far done includes measurements of foundation yield, rib distortion, and temperature in large bridges at Conneaut, Ohio, and Danville, Ill.; measurements of pier and abutment movements in nine bridges at other points (now in progress); and laboratory investigations (in progress) on effect of slenderness ratio, on skew arch stresses, and on flow or time yield of concrete. Future work is to cover the complete analysis of skew arch investigations, the deduction of a theory for the design of through arch ribs, a summary of knowledge on seasonal stress changes, studies of the effect of time yield of concrete on stresses, and studies of the stress effect of elastic piers and elastic spandrel columns.

Failure tests of arch ribs to determine the effect of their slenderness on strength have been made (at the University of Illinois) on four ribs, of span 19 ft. 3 in., rise 4 ft. 6 in., and crown thickness 4 in., and of respective widths of 16, 12½, 9 and 4 in. They were tested in a testing machine under loading at six points, with line of pressure kept inside the middle third. The unit stress at failure was not much affected by slenderness ratio, and agreed roughly with the crushing strength of 6x12-in. control cylinders. Failure occurred with striking abruptness in all cases. These tests will be repeated.

Pier tipping on the Conneaut and Danville bridges, which have rock foundations, showed as maximum 90 sec. and 50 sec. of arc respectively. Corresponding measurements on other bridges have not yet been evaluated, but are expected to reach very much higher values where foundations are other than on rock.

Flood Data—Repeating its suggestion of last year, the committee on Flood Protection Data, through N. C. Grover, asked that the society endeavor to find means for providing funds by which the data collected can be analyzed and reduced to usable form. This work is highly important, but cannot be done without special engagement of an expert engineer for the analysis, which is expected to take a considerable time. Attempts to have this work contributed by a government bureau have not succeeded, the Bureau of the Budget standing in the way. R. E. Horton and Morris Knowles in discussion emphasized the importance of doing the work soon. Mr. Horton referred to Mr. Grover's statement that the probability method of study has yielded valuable results in estimating the periodicity of floods of various magnitudes, and if favored by the committee, suggested that attempts should also be made to fix the absolute maximum flood for a given stream. In his opinion, the possibilities of nature as to size of a flood on a given stream are limited, and this limit should be found.

Steel Column Research—Extensive work is being done by the Steel Column committee, directed by Prof. F. E. Turneaure. Its program embraces study of the strength of short columns relative to the elastic properties of the material, the strength of long columns independent of detail weakness, the effect of details, and the action of columns as part of a structure. Much work has been done on the first two items, and some on the third, but wholly in the direction of bringing together and analyzing the results of prior experimental work. It is intended to carry such study through before determining on the needs for and scope of a program of further experimental investigation.

Irrigation Hydraulics—Nine subjects are under investigation by this committee, D. C. Henny reported. Evaporation losses from reservoirs, evaporation from soils, losses in canal conversions, water movement and pressure under dams, losses in siphon spillways, the silt problem, chutes and drops, scouring below dams, measuring irrigation deliveries, and the design of side channel spillways. The subject of permissible canal velocities has already been disposed of in a paper by Fortier and Scobey, published in *Proceedings* last September.

Stresses in Railroad Track—Prof. A. N. Talbot reported that the track stress studies during the past year were centered on rail joints, in which deflection, twisting and movements of splice bars were measured on three railroads under various loads, the measurements including also strains on various gage lines of the splice bars, tension in the bolts, and stresses in the rail. Items of the subject that are being considered cover most of the elements of joint construction and may lead to the question of improving the design of the splice bar. The data are still in course of analysis.

Cement—Thaddeus Merriman presented the progress report of the Special Committee on Cement, which was signed by him and by John R. Baylis, but not by Prof. A. N. Talbot, the other member of the committee. The committee has started on the basis that present knowledge regarding hydraulic cement is indefinite and unsatisfactory and the problem one which cannot be solved by direct experimentation. The report outlines the things that are to be determined as to (1), how and why cement sets; (2), what are the conditions necessary to bring about the set; (3), the type and form of the compound which will produce the best quality of material after set; (4), how aggregate affects set and what is the action of foreign substances; (5), how cement may be made less soluble in water. These things, the report says, may be determined by the synthetic method, which is being excellently followed in the portland cement fellowship under the auspices of the United States Bureau of Standards. The committee, however, is proceeding by the analytical method, which embraces the study of differences in behavior in different cements. The report outlines a number of these investigations, none of which is sufficiently far along to permit conclusions. It further inquires whether or not a standard specification is desirable, in view of the possibility that there may be need for different kinds of cement for different uses. Some suggestions regarding possible improvements of testing specifications are also made.

Standard Contracts—A copy of the standard form of contract developed by an inter-society conference last February was presented by the committee on Standard Construction Contracts (J. S. Langthorn). In discussion, several members referred disapprovingly to the copyright notice attached to the form of contract, and especially the additional copyright notice giving credit to the American Institute of Architects. Prior work of the Western Society of Engineers, the American Railway Engineering Association, and other organizations and individuals, which antedated and anticipated the A. I. A., were mentioned. J. C. Irwin asked for a careful study of the various clauses of the proposed contract, and suggested that it contains radical innovations whose effect on the workability of contracts should be carefully considered before adoption of the form.

Arbitration—The committee on Arbitration, E. J. Mehren reporting, mentioned the progress made in extending and strengthening arbitration through legislation during the past year, and quoted the arbitration law adopted in New Jersey, which when arbitration is agreed upon by the parties to a contract makes it of binding force and gives it a quasi-judicial status.

Contract Bonding—Questionnaires designed to elicit full information as to the financial and technical responsibility of bidders were drafted by an inter-society conference on bonding last summer. These questionnaires were reported to the society by the Contract Bonding committee, Frank C. Wight, reporting.

Bearing Value of Soils—Robert A. Cummings, chairman of the Soils committee, reported that the decision has been reached to close up the work of the committee by preparing a series of studies of research information and modern practice in the several fields of soil engineering. The final report will thus constitute a complete manual of the state of the art. Assistance in this work is requested from all members.

Effects of Earthquakes—A progress report from this committee indicates that all material is at hand for a report on earthquake knowledge and effects based on Japanese and American experiences.

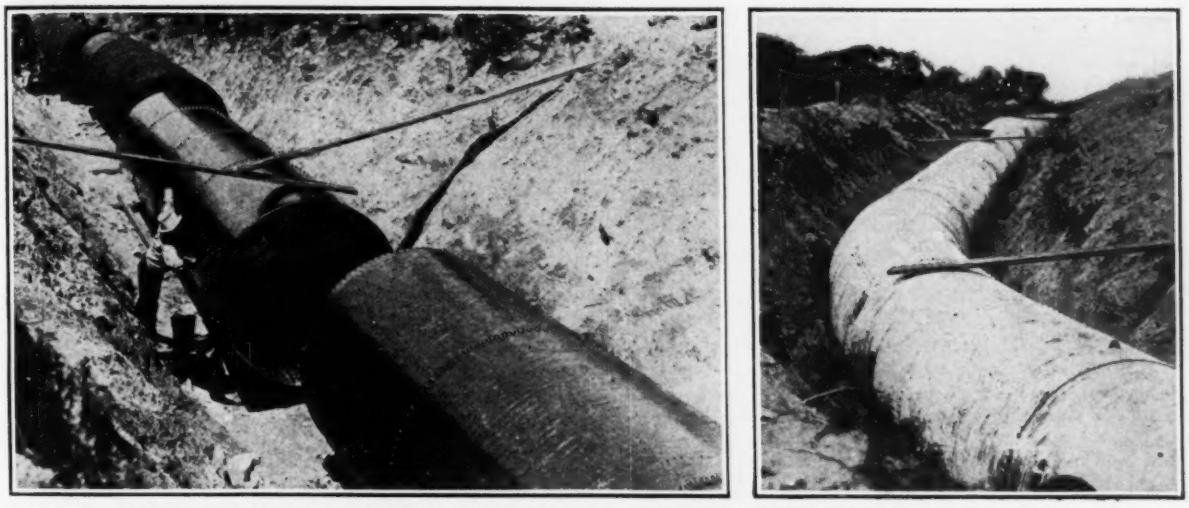
Construction of Steel Portion of Providence Aqueduct

Nearly Two Miles of 66-in. Steel Pipe Coated at Trench Side—Collapse and Restoration of 2,200 Ft. of the Line

By Bayard F. Snow
Resident Construction Engineer, Providence, R. I.

BETWEEN the city of Providence, R. I., and her proposed new source of water supply, the Scituate reservoir, an aqueduct is being built of which over three miles is concrete-lined tunnel through rock, somewhat over a mile is open-cut reinforced concrete and nearly two miles at the city end is riveted steel pipe. This pipe is 66 in. in diameter for 8,300 ft. and 48 in. for the remainder of its length, and with the exception of a short section under and adjacent to a railroad track, where ⅜-in. plate was used, is rolled from ¼-in. plate conforming to the A.S.T.M. serial designation A7-21. Special features of the construction of the steel pipe section of the aqueduct, to which this article is devoted, are the coating of the pipe alongside the trench, the care used to prevent damage to the coating in backfilling, and the collapse and restoration to shape of 2,200 ft. of the 66-in. steel pipe. The topography along the steel pipe section is irregular and necessitates deep cuts in sandy knolls as well as several fills, one across a small swamp, thus giving a variety to the construction usually found only on longer lines and making progress somewhat slower than if methods of operation once inaugurated could be followed for considerable distances.

Excavation was begun about the first of April and the first pipe was placed early in June, 1925, from which time progress has been steady but not rapid, running between 500 and 800 ft. a week. All of the pipe has been laid, riveted and field tested with the exception of less than 2,000 ft. of the larger size and the connections to the city mains, and backfill has been placed on three quarters of the line. In placing backfill, careful inspection and workmanship are necessary to avoid injury to the coating. In stony ground a power shovel places the earth conveniently to allow four men to handle it, shoveling against the pipe so as to cause any stones in the material dropped by the shovel to roll against the bank of the trench. It has been found possible in this way to backfill 200 ft. per day, averaging over 2 cu.yd. per lin.ft. A short section of pure sand in a wide and deep trench was filled at a rate of nearly 1,000 yd. per day. Holes under the pipe for riveting and coating field joints are washed full of earth with a hose and it was first planned to carry this compacted fill up to the center of the pipe. After backfilling was begun, however, it was found impracticable to use water to compact close to the pipe without inviting injury from stones rolling into the pocket thus formed against the pipe, and since tamping was vetoed because of probable injury to the coating, the following method was evolved. After the pipe was laid a small gang built up low dikes near the end of the 30-ft. pipe sections and washed carefully selected material into the trench up to a level a foot or more above the bottom leaving only the field joints exposed. These joint holes were filled later as mentioned above.



CONSTRUCTION WORK ON 66-IN. STEEL PORTION OF NEW AQUEDUCT FOR PROVIDENCE, R. I.
Left: Section in foreground has had its two coats. Second section has had two coats inside and man is starting on second coat outside. Third section not yet coated. Right: Portion of pipe ready for testing. Manhole barely shows in foreground. Whitewash applied on outside was effective in prevention of flow of enamel coating.

All of the coating work was done in the field, mostly alongside the trench. The pipe as received is rusted to a considerable degree except where protected by the mill scale, no pickling and no shop coating having been used. Both cleaning and coating are carefully done and it is thought that the result is superior to any dipped protection. After removal of all rust and loose scale by scrapers, brushes and cloths, the "bitumastic solution" is brushed on cold after which the "bitumastic enamel" is heated and applied. This second coat cools so rapidly that the brush marks remain very much in evidence, consequently it is desirable to make the strokes longitudinal of the pipe on the inside. The field joints must be coated after the pipe is assembled, and there is always some touching up to be done where tools have been dropped, although this enamel is remarkably tough and elastic. Whenever pipe laying is in progress and when backfilling in stony material is going on, it has proved necessary to keep a small amount of hot enamel ready for use. Before

laying, the pipe is held in mid air long enough for a last inspection and touching up of the bottom, and during backfilling an occasional stone strikes the pipe hard enough to break the enamel, calling for stoppage of work until the damage has been repaired.

In general, the pipe was transported by tractor and lumber reach to a position as near the trench as practicable. For one stretch of 2,000 ft., however, the pipe was coated in a yard adjoining the line, rolled on skids to a stiff-leg derrick, lowered to a car on an industrial railway and carried to its position, where the sections were lifted by a tripod and hand winch while the cars and track were removed. This method, adopted because the topography prevented the use of the power crane, proved more satisfactory than the other one both for coating and laying the pipe.

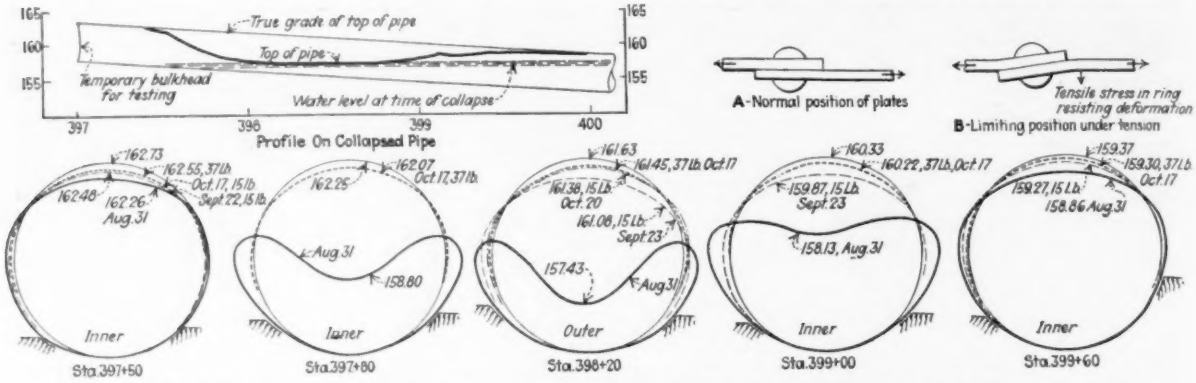
The trench, 5 ft. wide and with slopes of 1:1 except where the nature of the earth required flatter slopes, was graded some time in advance of pipe laying. In some sections of trench considerable redressing was necessary and was done, together with bell hole excavation, immediately ahead of the pipe crew. Stakes were set on line 3 ft. ahead of the station of the joint and were marked for grade as of the point occupied by the stake rather than of the pipe joint. This was done for two reasons: (1) It allowed the inspector to check the grade with a string stretched from a point within the pipe along the invert to the stake without any transfer of levels, and (2) it was early found that the lengths of pipe did not agree absolutely with the erection drawings but "crept" to such an extent that at "filling-in sections," where closures were made about 2,200 ft. apart, the gain was over 3 ft. By measuring the amount of this gain at intervals and setting stakes to allow for it no real difficulty has arisen although some adjustment is necessary for line or grade at each change of direction of the line. In the section not yet laid, a 20 per cent grade in a ledge cut terminated by horizontal angles and flat grades makes it necessary to have joints located as laid out, and since there is no "filling-in section" for a greater distance than elsewhere, it is evident to the contractor that he must make some provision to allow placing this part of the pipe as called for on the erection drawings. It has been decided to stop laying pipe near the foot of the hill, where a "creepage" of about 3 ft. has been found, and begin again at a point above the steep rock cut, first working west to the end of the line then east to effect a closure. In this way the pipe on the hillside will be set practically as called for instead of 5 ft. further west, as would be the case if progress had been continuous and no allowance for "creepage" made.

Collapse of Portion of Line—The failure of one of their employees to carry out orders has cost the subcontractor considerable money and worry. The orders were to remove drop-hole plugs before drawing off water after a test. The first section, about 2,200 ft. in length from the end of the 66-in. pipe to the summit, where an air valve was called for, had been tested and found tight. The air valve was not yet in place, as it came immediately beyond the temporary bulkhead, so before drawing down the water sufficiently to permit removal of the bulkhead, a man was sent up the hill to remove the drop-hole plugs. A small drain was opened, while for some reason the man delayed two hours, reaching the summit just as 200 ft. or more of the pipe buckled in on top, causing what looked like a total loss of at least seven 30-ft. sections of pipe. This occurred on Aug. 20, since which date efforts have been made to bring this collapsed pipe into shape with such success as is indicated on the accompanying photographs and line drawings. It is of interest in considering the re-shaping of this pipe to note that a change from a circle 66 in. in diameter to an ellipse of the same perimeter but with a major axis 1 ft. longer than the minor reduces the area only 2 per cent or approximately the same as is the change in area at each transverse seam. This reduction in area is not considered to be a determining factor in the acceptance or rejection of the pipe but since a flattened upper surface might prove weak in case any heavy load should ever come upon it, the following methods were used to correct the flattening and prevent any tendency toward weakness under load:

1. Regular city pressure of 15 lb. at the summit was turned back into the collapsed pipe, bringing it to approximately 6 in. below the circle.

2. Test pressure (35 lb.) 20 lb. higher than that just noted was tried but did not effect any permanent benefit, although the shape was improved while the pressure was on.

3. The water was drawn down and 35- and 50-ton jacks were used inside to increase the vertical diameter. Hardwood shoes were used, shaped to the radius of the pipe to prevent injury to the pipe coating. These jacks were placed at each transverse seam, care being used to exert the stress on the inner ring rather than on the outer which would open the joints. This jack-



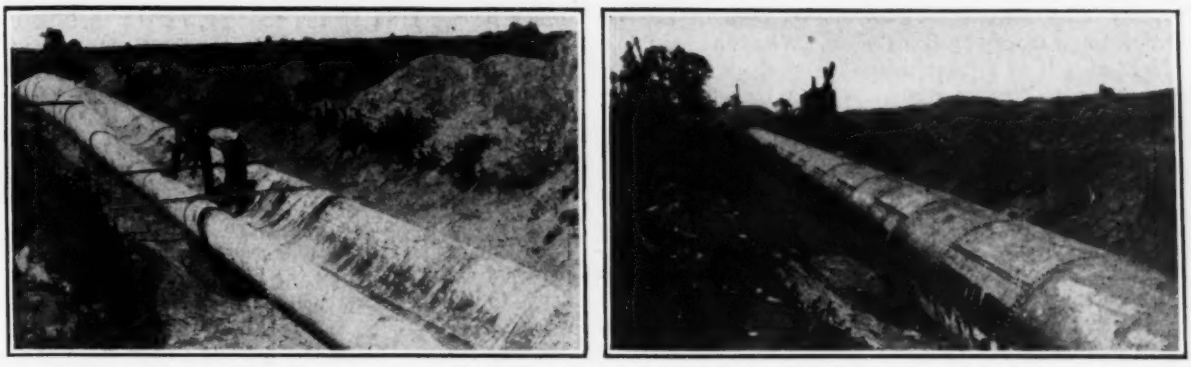
SECTIONS AND JOINT DETAIL OF COLLAPSED PORTION OF 66-IN. STEEL AQUEDUCT FOR PROVIDENCE, R. I.
Deformation and almost complete restoration to circular shape. Joint detail shows permanent deformation.

ing, continued from joint to joint, increased the vertical diameter to between 2 and 3 in. above normal, which increase was held by 6x6-in. struts.

4. The jacks were now used between the bank and the sides of the pipe to decrease the horizontal diameter and take out the sharp bend which resulted from the reversal in the shape of the top. There appeared to be an improvement in the shape of the pipe from this operation but there was no loosening of the struts inside.

5. The struts were now removed and the pipe again filled and test pressure applied, bringing the pipe very nearly to correct shape.

All coating which could possibly have been damaged by the sharp bending and other treatment it had undergone was chipped off and the pipe cleaned and recoated, after which, under full test pressure (the maximum to which the pipe can ever be subjected under future operating conditions) puddled backfill was placed to the full capacity of the trench up to the top of the pipe. As this is written the fill over the collapsed section is being placed and the pipe is being laid on the rocky hill at the west end of the contract.



COLLAPSED STEEL PIPE AND NEARLY THE SAME STRETCH RESTORED TO SHAPE BY WATER PRESSURE

In reshaping the pipe which collapsed, results fully as good if not better could probably have been obtained at less cost by cutting the line at the end of the collapse, inserting a bulkhead and raising the pressure to the maximum permitted, in this case about 100 lb. per sq.in. Had that been done and pneumatic hammers been used to set up vibrations, the writer believes the cost would have been less than was the case.

An interesting fact in connection with the collapse was that in each outer section the buckling of the pipe caused a permanent deformation at the top of the pipe adjoining the transverse seam. The cause of this is believed by the writer to lie in the greatly increased longitudinal stresses at this point.

The change in shape necessitated a lengthening of the upper elements of the cylinder, causing longitudinal tension. At each joint this stress was offset in a radial direction, causing a flexing of the joint. The outer plate could move inward more freely than the inner could move outward since ring tension tended to restrain the latter movement. As a consequence the pipe now has noticeable depressions at the points mentioned (see detail) but since no harm is anticipated from them, they have been allowed to remain.

Aside from the collapse just described, the work has progressed satisfactorily, but there are a few points which should be brought out for the benefit of those whose problems are similar. It is believed that where alignment and grades permit, the pipe is more cheaply and efficiently handled from a yard adjacent to the trench than by placing it alongside the trench. Whether in a yard or placed alongside the trench, pipe should be carefully lowered to skids which are long enough to permit rolling for application of the coating and high enough to keep the pipe from contact with the earth.

The general contractor for the steel pipe section of the aqueduct is Charles A. Haggerty, Webster, Mass., who sublet the furnishing and placing of the pipe to the Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. The coating was furnished and applied by the Wailes Dove-Hermiston Corporation of New York. The writer is resident engineer in charge of construction under W. W. Peabody, deputy chief engineer, and Frank E. Winsor, chief engineer.

New York State Prohibits Cross-Connections

Cross-connections between potable water-supply systems and any other systems of water supply in New York State are prohibited by regulations adopted by the Public Health Council of New York State at a meeting held Nov. 12, 1925, with the exception that they may be permitted if the other water supply "is regularly examined as to its quality by those in charge of the potable water supply" and is "found to be potable." All existing physical connections with the exception just stated must be severed by July 1, 1926, unless they "include two gate valves with indicator posts, two check valves of the Special Factory Mutual Fire Insurance design or equivalent with drip cocks and gages for testing, all located in a vault of watertight construction accessible for ready inspection," in which case the time is extended to July 1, 1928. Water from a potable supply may be used as auxiliary to another supply provided the potable water is delivered into a tank open to atmospheric pressure and discharged above the high water line of the tank. Where industrial plants have a potable water supply available, no other supply shall be delivered in such a way that it can be used for drinking purpose unless the other supply is approved by the local health officer. If no public water supply is available in an industrial plant, then "the water for drinking and other domestic purposes shall be of safe, sanitary quality approved by the local health officer." The regulations do not apply to New York City, which is outside the jurisdiction of the State Department of Health.

Florida as an Engineer Sees It

A Series of Articles on the Human and the Engineering Significance of the Greatest Land Boom in the History of the Country

By Frank C. Wight
Editor, *Engineering News-Record*

II—Engineering and Contracting Conditions

WITHOUT the engineer and the contractor the Florida real estate boom would be a frivolous and empty thing, for climate, even Florida's climate, does not attract new money by itself alone. What has been done in Florida is to attract thousands, perhaps millions, of investors and prospective residents by physical evidences of development, by making roads where once jungle was, by building homes with all the conveniences of a modern city where a year ago was only sand and pine, and by turning a swampy shore into a tropical winter resort. To do this at all takes engineering skill; to do it in the short time that has been permitted has required both engineering skill and construction enterprise.

In consequence Florida today is full of engineers and contractors. Some of them are the best the country affords, some of them are so-so and some of them are of the dregs. More are coming in every day and the lurid reports of Florida that are spread over the country are arousing in many more the itch to go there, to see for themselves what the conditions are and to join, too, in the new exodus south. This article, then, will briefly tell what the engineers and contractors are doing down there, what the conditions are under which they work, so that those who have not yet followed the almost universal impulse to go down may have some idea of what their fellows are doing in Florida and what the prospects are for those who may come after.

Engineering Licenses—In the earlier article on the Florida real-estate boom (*Engineering News-Record*, Jan. 14, 1926, p. 58) it was made evident how important a part the engineer was playing in the new developments. The larger operations with their complications of design, layout and construction demand the highest type of engineering skill, and the interests behind these operations have been very wise in procuring skillful engineering service. From this high type of work the demand for engineers extends down through the line to the lowest order of surveying. Florida has been sold on the need for engineering services, but the bad always goes with the good in such a reform and the mediocre practitioner manages to slide into the inclosure along with his more practiced brother. The demand for engineers has been so great, however, that the report has spread all over the country and from every state engineers, good and bad, have been pouring into Florida.

The degree of this influx may be measured by the records of the Florida State Board of Engineering Examiners. Engineers in Florida operate under a license administered by this board. Up until 1925 the board met twice a year and had, by such leisurely methods licensed up until Jan. 1, 1925, about 600 engineers. In 1925, however, the pressure became so great that two meetings a month have been held and in the year over 400 new registrations were recorded. Applications continue to pour in to the board at an equal rate.

The license law of Florida is fairly comparable to the other license laws of the country, except that in December the Legislature passed over the Governor's veto an amendment of the license law which reduces the stated experience requirement for professional engineers to three years without graduation and eliminates any experience requirements for the graduate. Both requirements, however, are subject to an examination and determination by the board of the applicant's possessing the necessary engineering knowledge. Those not having experience requirements will be subjected to personal examination by the board and rulings to conform to the new law will be formulated at its next meeting.

Every one practicing engineering in the state has to be licensed and, while there is a reciprocal registration provision in the act, regular application and licensing are required of those registered in other states as a preliminary to operation of the reciprocal arrangement.

Surveying Licenses—The license law, however, does not entirely insure proper surveying, which constitutes a large part of the engineering work in the state. An engineering licensee is commissioned to conduct surveys, but only under another act of the Legislature known as the Plat Bill. This bill provides that every recorded survey plat shall be certified by either a competent surveyor or a licensed engineer. Further than that, if the surveyor signs himself as a civil engineer without having a license therefor the bill provides that there is automatically thrown a cloud on the title, in addition to which, of course, the surveyor is subject to such punitive measures as the State Board of Engineering Examiners chooses to exercise for violation of the law for the practice of engineering. However, the Plat Bill also provides that the commissioners of each county may certify surveyors and these surveyors need not have an engineering license. Such certification is applicable only within the county where granted, but in that county a survey signed by a county certified surveyor is equally valid with one signed by a licensed engineer. It is probable, though not provable, that the county commissioners are much more lax in the issuance of surveyors' certifications than is the state board in the issuance of engineers' licenses, and there are unquestionably a number of certified surveyors whose work would be far from acceptable by an engineering license board.

It is somewhat difficult to decide just how the engineering license law is working in Florida. Most of the engineers talked with agree that it has been a desirable brake on the too great influx of low grade engineering talent into the state. The license board has exercised

full statutory rigidity in consideration of candidates, but there has been no written examination required under the Florida law and the board has been able only to decide from a man's general reputation and the report of certain known engineers as to his qualifications for practice. By and large, it appears that the engineering talent coming into the state is adequate for the work in hand. A great number of applicants have been rejected. In some cases they have attempted legal redress, but so far the courts have not overruled the license board in its decision. There have, too, been some prosecutions of engineers for practicing without license, which has had a salutory effect in restraint of unlicensed work.

Quality of Engineering—At the same time, there is a great deal of poor engineering work going on. Reputable engineers report that they all the time are brought into cases to clear up inadequate or erroneous surveying or to straighten out obvious design mistakes. One survey of a new real estate development turned out to be absolutely incomprehensible because the professed surveyor seemed to be unable to distinguish between north and south and east and west in his descriptions, an elementary ignorance which resulted in a very obvious detraction from the value of any plat made. There is no doubt that in the future there is going to be a great deal of litigation and difficulty in Florida when certain buyers of property which they have never seen go onto the ground and try to locate from a botched up survey lots which are beautifully recorded on blueprints. In a minor way, too, there doubtless will be difficulties in check up of the measurements, because a great deal of the survey work is being put through at greatest speed and with a minimum of service, and under such conditions great accuracy is, as a rule, impossible.

In another case a so-called engineer who had managed to get a license put in a sewer system for a small community which unfortunately, when put into service, was found to run back into the town instead of through the town into a nearby watercourse. The usual Florida sewer has to be laid out in such flat country and on such low grades that it is conceivable that a level not quite in adjustment might cause just such a reversal of flow line, assuming that the surveyor was not too careful to check his points.

In the larger work, however, there is no criticism to be made of the engineering which is being done. Some of the best engineers of the United States are working in Florida and the results of their work are evident. They are spending just as much time and putting just as much of their skill into it as they are into more leisurely work in other parts of the country. They are hampered by the demands for quick action just as the same and fellow engineers in the early days of the war were hampered in the war construction work, but nevertheless they are carrying out their professional obligation to the full.

This efficiency is particularly true in municipal work where rapid enlargement of the cities has brought about demands on the public service of unprecedented magnitude in Florida. In every one of the cities, practically, water supplies are being extended, sewer systems are being enlarged, sewage purification is being installed, and city planning, which involves not only the widening and bettering of mid-town streets but also the proper extension of the suburban areas, is under way.

Chance for Engineers—What is the chance for engineers now in Florida? Generally speaking, it appears to be fairly limited. The supply seems to be equal to the demand. A number of employing engineers reported that they could take on junior engineers almost to an unlimited degree. These men would get good salaries, but they would have to remember that living conditions in Florida are very expensive and for the man without too much money not particularly attractive. The difficulty that these employing engineers seem to experience is that as soon as they get a good junior engineer who is worth anything he either decides inside of three or four months that there is more money in selling real estate or else some real estate developer, who is anxious to get comparatively low-priced engineering service, takes him on as chief engineer of one of the minor developments. This proclivity may serve as an attraction to young engineers to go to Florida, but it is doubtful if such employment is in the long run worth while to any one. A certain amount of extra money may be made over a short time, but the chances for permanent advancement are greater with a permanent engineering organization.

Engineers in some of the sections of the state have organized associations which have established uniform fees for engineering work and which keep tab on unreliable real-estate developers for mutual information. Just how far such organizations have gone is not a matter of public record. It may be that the engineers connected with them feel that they are engaged somewhat in a combination in restraint of trade, but they feel, too, that the situation in Florida today is so exceptional that some arrangement in defense of themselves at least temporarily, is necessary. New developers are none too reliable in their payments and a trade association of professional men seems to serve to restrain the realtors' undesirable methods.

Conditions in Contracting—Statistics as to the number of contractors who are operating in Florida are not available since contracting requires no state or county authority. The influx of outside contracting firms into the state, however, has been remarkable and the development of the local companies equally so, for there is an immense amount of work for the contractor in Florida today. The most apparent work is that of large building. Comment has been made on the dozen or more skyscrapers under way in the city of Miami. In minor degree, the same condition exists throughout the state. I, myself, went through fourteen hotels under construction, the smallest of which would cost easily $1,000,000 and the largest possibly $10,000,000. Such structures are being built by the highest type contractor under the most improved methods and with exceptionally good engineering and architectural design and control.

The next most important contracting work is the turning of raw Florida land into a real estate development. In the numerous secondary operations of this sort the contracting is of minor consequence. A gang of workmen is sent in with the assistance of such machinery as the developer can afford and a superficial clearing up of property with the cheapest kinds of sidewalks and roads results. In the larger work, however, the development becomes a well-ordered contracting operation and the chief engineer of the contractor has to develop an organization comparable to those which handled cantonment construction during the war

Here machinery is used to the utmost. Tractors are universal motive power, steam shovels on crawler treads indispensable, and hydraulic dredges for the major draining and canalizing operations imperative. On such developments the contracting work is of a high order. The streets and roads are well built, the sewers and water mains placed with a fair approximation at least to modern city practice, and the bridges and buildings making up the permanent improvements of the subdivisions fully adequate. The only drawback to the highest class work is the necessity for speed which is always present under the drive of the high-pressure sales manager to whom finished improvements are impressive selling arguments.

Labor Conditions—Contractors contemplating entering the Florida market, however, should be warned that building in Florida today is anything but a pleasant performance. Labor would be expected to be fairly plentiful in such a climate. So far as one can find out, it is plentiful but it is expensive and it is not altogether happy. Most contractors are paying common labor the usual price for such labor in the South, which is somewhat below labor prices in the North, and such common labor being mostly negro is not particularly worried about its living conditions, but skilled labor is getting more difficult to obtain on account of living conditions. Skilled labor is getting the regular New York wage scale in most places in Florida, but the demand is so great that there is the usual bonus for overtime with the accompanying usual overtime which makes the skilled labor rates about as high as they have been anywhere in the United States at any time, even in the boom wage period just after the war. At that, the skilled laborers are not satisfied because it takes practically all they can make to live. With the mobs of people pouring into Florida today, even into the less settled districts where construction work is under way, housing is terribly congested. On work going on in the vicinity of the larger centers it is practically impossible for a skilled laborer to obtain any kind of living quarters which are comparable to what he could get in other parts of the country for any price within his means. When it comes to foremen and superintendents who are bringing their families with them, the contractor must count on a considerable addition to the usual salary if he hopes to keep his men. In some of the remoter construction work the contractor has solved his difficulty by putting up camps and in some cities efforts have been made to build apartment houses for the workmen to be used during the period of the contract and sold thereafter, but most of the contracting firms who have contemplated this have found that prices for land are so high as not to warrant the projects. Taken all in all, a contractor expecting to come into Florida for the first time would better spend a considerable period looking into his labor problem before he attempts a bid.

Materials—Here difficulties are great. The railroads entering Florida have not for some time been able to handle the great influx of material that the boom has brought about. In consequence, an embargo was laid last fall on everything except perishable goods. This embargo still exists. It is being ameliorated to some degree by a license plan whereby certain material is allowed to go through on plea of imminent necessity, but very little actual building construction material is getting south of the Florida northern boundary by rail. There are rumors of bootlegging in freight which are not very pleasant to hear; that is, stories of favoritism one way or another whereby certain contractors get delivery on material that they want. This, however, is mere rumor and need not necessarily be credited. It is certain, however, that anyone who gets building material today anywhere in Florida is fortunate and can ask almost any price he wants for it. Armed guards are placed around cement sheds to prevent burglary, and contractors' foremen and superintendents are almost daily approached to see whether by some means, generally foul, material cannot be diverted from their warehouses to that of some one else.

Some building material is coming in by water, but the harbor facilities of Florida, as will be described in another article, are none too good and this source of supply is limited. At Miami, it was reported by one who should know, that about 100,000 bbl. of foreign portland cement is coming into that port every month. Practically all of the reinforcing steel in the Miami district, too, is from Europe. The west coast is able to get some of its supply of building materials from the gulf ports—Mobile, New Orleans, Galveston, etc.—but transshipment out of Tampa, the only good west coast port, is limited to the capacity of the railroads to carry it, which means that the east coast does not benefit thereby.

For concrete work, the local lime rock is being used extensively, although up to a few years ago this was not considered to be proper material for concrete. The more conservative engineers are still importing their aggregate from the North, though very little of it is getting in in any way except by barge. It is reported that for some of the work on one of the Palm Beach hotels the need for stone aggregate was so great for the concrete that such aggregate is being imported from Cuba at a cost of around $8 per yard. In contrast to this, some concrete on a third or fourth rate development was seen where natural cement and beach sand constituted the major ingredients.

Finances—How do contractors get paid? That is a thing that is difficult to find out. Evidently they are getting paid, but most of them will tell you that they are not extending their work very far beyond the visible cash in hand. Where the contractor is operating with a well-known company whose sales are so far ahead of construction that it has money in the bank, he need not be worried, but only a few of the developments are in this fortunate condition. So the contractor works too frequently with his left hand building with the money that his right received the day before. The developer, however, knowing that his main stock in trade is the visible evidences of the contractor's work, more often than not gets his money from some one else before he tackles the contractor, so that the contractor if he is shrewd enough has his money assured before he starts work.

From this brief survey it should be apparent that today Florida is no place for the pioneer engineer and contractor who wishes to operate on his own. There are still jobs to be had, but for the most part they are just jobs. The adventurous may wish to take a try at them, but they should do so with full expectation of disappointment.

From Job and Office

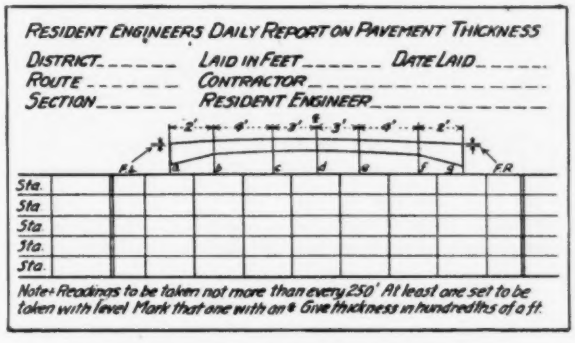
Hints That Cut Cost and Time For the Contractor and the Engineer

Method of Taking Readings to Check Pavement Thickness

By C. M. Hathaway
Engineer of Construction, Illinois State Division of Highways, Springfield, Ill.

APPRECIATING that the strength of a concrete pavement is a direct resultant of its thickness, and anticipating future motor truck loadings on our highway system, we must, more than ever before, realize the paramount importance of a full thickness of pavement being obtained at all times. Cores taken at frequent and regular intervals are a most satisfactory check of thickness but by this method the information cannot be available until a large percentage of the entire job is completed.

Early in 1925, a method was devised by the Illinois State Division of Highways whereby pavement thickness can be measured daily, thus assuring both the contractor and the engineer of the desired information


Resident Engineer's Daily Report on Pavement Thickness
District_____ Laid in Feet_____ Date Laid_____
Route_____ Contractor_____
Section_____ Resident Engineer_____
2' 4' 3' 6' 3' 4' 2'
FL
a b c d e f g
FR
Sta.
Sta.
Sta.
Sta.
Sta.
Note:- Readings to be taken not more than every 250'. At least one set to be taken with level. Mark that one with an •. Give thickness in hundredths of a ft.

REPORT CARD FOR SLAB THICKNESS TESTS

as work progresses. The method is simple and consists merely of taking readings on the subgrade just before the pavement is placed and then later taking readings on the finished pavement at the same identical points, as soon after final set as practical.

The proposition may be best explained by studying the accompanying figure, which is "Resident Engineer's Daily Report on Pavement Thickness." Anticipating an average daily run of 600 to 800 ft., it will be noted that at least three determinations are expected daily, preferably one early in the morning, another at noon, and a third shortly before closing time, additional readings to be taken when the length of "run" increases.

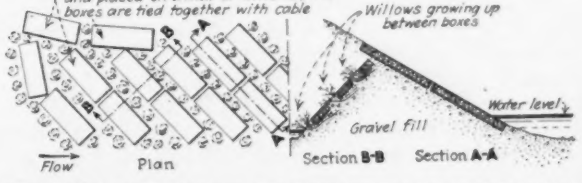
Instrument readings are regarded as more accurate, but the method of stakes set close to the side forms and measurements from a tight string may be resorted to, when, for any reason, an instrument is not available. Field notes are kept in a separate book, which is made a permanent record of the job and the resulting figures are recorded directly on the report card. The points on the cross-section, at which readings are to be taken, are plainly indicated on the report and the letters "FL" and "FR" refer to "before" and "after shots," on the left and right side forms; the latter to determine whether or not there is any settlement of the forms.

Resident engineers are instructed to send one report daily to the central office and one report to the district office. Thus, with this complete information at all times available at headquarters, there is afforded ample opportunity for a careful analysis of results obtained on each job, day by day. The only time involved in taking these readings is that of the engineer and a rodman and there is no delay to the contractor's operations. The figures become a permanent record of the job and may be checked later on by the cores.

This system has been in operation during the season of 1925 and the results obtained have been very satisfactory. They warn the contractor when his pavement is running deficient in thickness and permit of immediate correction. Likewise, when it is demonstrated that the pavement is running an excess thickness, the contractor may make suitable adjustments and thus eliminate uncalled for expenditure.

New Willow Bank Protection Tried Out by California Highway Department

A NEW PLAN for protecting banks, a departure from the usual type of willow protection work, is being tried by the bridge department of the California State Highway Department, at the approach fill at the south abutment of the Van Duzen River bridge, on the Redwood highway in Humboldt County. Timber boxes 1 ft. x 4 ft. x 10 ft., constructed from 2-in. material were placed on top of a mat of willows, as shown in the accompanying sketch. The boxes are designed to pre-


Wooden boxes 10'x4'x 12" filled with gravel and placed on a mat of willows, the boxes are tied together with cable
Willows growing up between boxes
Water level
Gravel fill
Flow
Plan
Section B-B
Section A-A

DETAILS OF NEW TYPE OF WILLOW BANK PROTECTION IN USE IN CALIFORNIA

vent the willows from being washed away before they have grown to sufficient size to withstand destructive action of flood waters.

The boxes were set at a 45-deg. angle to the flow of the stream and at an angle of 15 or 20 deg. to the stream surface. When placed in this manner, they cause silt to be deposited on the young trees, materially aiding their growth. To prevent the boxes from being washed away, they were filled with coarse gravel, fastened together with cables, and anchored to the bridge abutment.

The willows, when planted, were placed with the small ends pointing upstream. Cuttings of not to exceed 1 in. in diameter were used.

As necessary materials were readily available, the

plan proved economical. The total cost was $247 for twenty-five boxes, or $9.88 per box installed. The protection was placed during March of this year. Despite two rises of the river since that time, the willows, on Sept. 1, showed a growth of about 2 ft. in height. By the time the next high water occurs, they should be well rooted.

TWO STAGES OF GROWTH OF WILLOW BANK

It was at the suggestion of Commissioner Louis Everding that this type of protection was used. He has been familiar with its effectiveness along Mad River, Humboldt County, where the plan has been followed for six years by the Northern California Redwood Co. The results so far, the bridge department believes, justify the recommendation of the commissioner.—*California Highways.*

Securing Easy-Riding Road Section by Careful Office Detailing

By George D. Burr
Assistant King County Engineer, Seattle, Wash.

IT SEEMS to be the current practice in highway organizations to lay intersections and non-standard portions, as well as standard sections of pavements, entirely from a plan showing alignment only and a profile showing center-line grade only. The inspector on the job is intrusted with the shaping of the surface and establishing of ribbon grades at such points. This practice has resulted in many poorly shaped sections of pavement, containing needlessly rough and dangerous spots. Another result has been the frequent changing of ribbons and subgrades at these points involving consequent delay and expense. The inspector cannot be held to account in most instances because he is working without the proper facilities.

This fault has been remedied in King County by laying out special detail sheets for these non-standard spots in a job. The detail sheets are made out in the office from carefully prepared profiles of each ribbon and each lane of traffic, giving due regard to superelevation, grade and drainage. At intersections, spline curves are run transversely across such profile lines to establish intermediate points. The finished detail sheet shows only such elevations as are necessary to shape the surface correctly, and these are placed at such points as are most easily located in the field. All points at which elevations are given on the detail sheet are set in the field as "blue tops" driven to subgrade elevation.

The results obtained in a particularly difficult situation are illustrated in Figs. 2 and 3. This curve lies on a road below a bluff on Puget Sound connecting a summer colony with the main traveled highways. A sharp curve was unavoidable so the problem resolved itself into one of making the best of a bad situation. After a careful study of the location the special detail sheet shown in Fig. 1 was drawn, with beneficial results that could not have been obtained by field methods alone in laying out the curve from a plan, profile and standard table of superelevation. Figs. 2 and 3 show the desirable effects produced. Fig. 2 is taken looking up grade and Fig. 3 shows the same curve viewed from

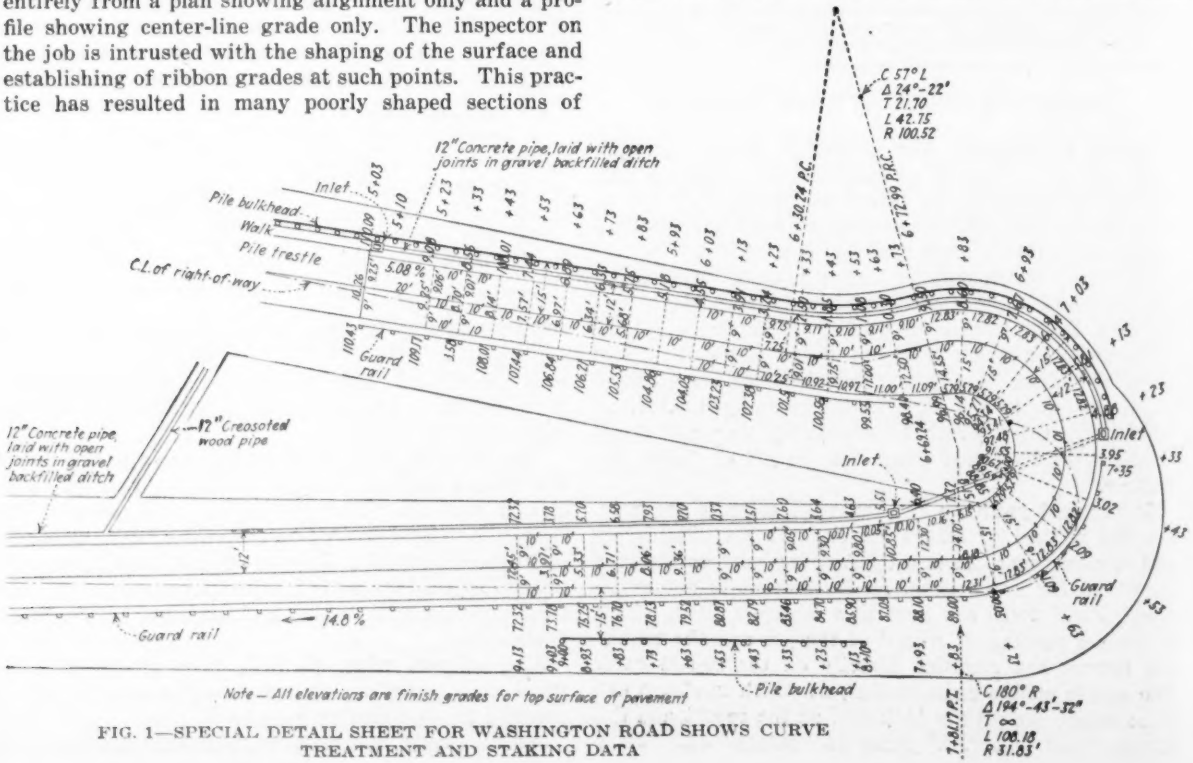


FIG. 1—SPECIAL DETAIL SHEET FOR WASHINGTON ROAD SHOWS CURVE TREATMENT AND STAKING DATA

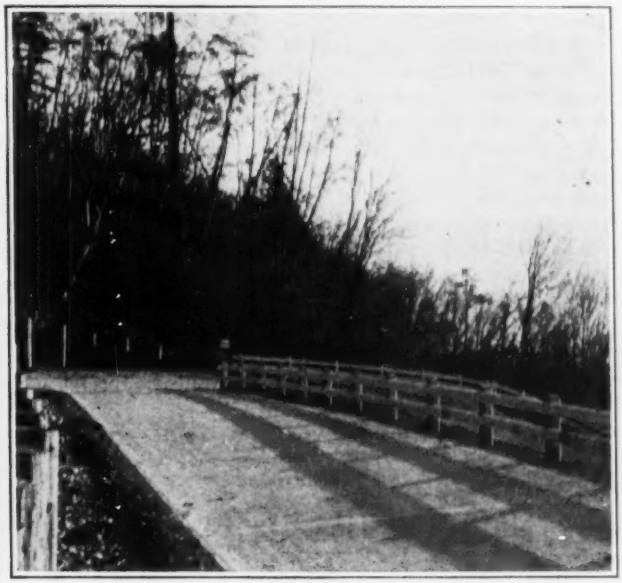
From Job and Office

Hints that Cut Cost and Time

From Job and Office

For Contractor and Engineer

the other point of approach. In spite of the adverse circumstances, grades and superelevation and smoothness have been kept to the requirements for which the roadway was designed.



FIGS. 2 AND 3—BOTH APPROACHES TO CURVE ON SPECIALLY PLANNED WASHINGTON ROAD JOB

Thomas R. Beeman is county engineer of King County. Don H. Evans is principal assistant engineer.

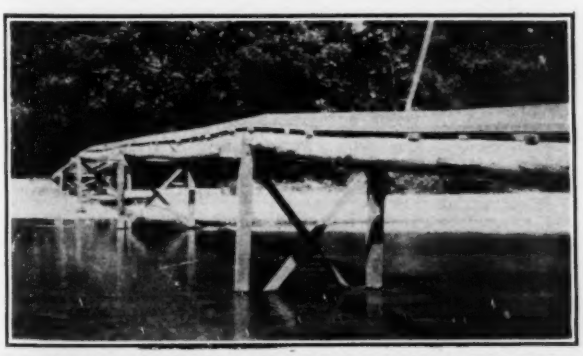
Trough Timber Bridges Built as Temporary Stream Crossings

By Edwin S. Austin
Fidelity & Casualty Co. of N. Y., Jefferson City, Mo.

WHEN the Missouri Highway Commission took over 7,640 miles of designated highway under its 1921 law it was found that many roads were merely paths through the wilderness and across streams that could not be forded with the moderate-sized automobile. Traffic demanded improvement and an effort was made by the maintenance forces to cope with the situation.

About that time a young engineer, just back from war, had been placed in charge of the maintenance work in a south Missouri division. He studied the situation over carefully. With tractors and scrapers he widened the strips of road through the Ozarks, but when he came to the streams it was another matter. These roads could not be constructed in at least five years, and yet they were in daily use. Automobiles could get over the roads, but these mountain streams were deep and filled with gravel. They were not easily crossed even in dry weather.

Elmer Axon, the young maintenance engineer, studied the matter over carefully and decided to build some temporary structures. They were usually built with a crib of logs at the bank filled with as large stones as could be moved. In the middle of the stream some heavy wood served as piers and upon this substructure were placed log stringers with cross pieces at intervals. Upon these stringers troughs of 2x4 planks were built just wide enough for the automobile wheels. These were raised at least 4 or 5 ft. above the water and served the purpose well. The result has been to encourage Chief Maintenance Engineer Claude Owen to provide many of these bridges as temporary expedients all over south Missouri. They do not always stand the strain of the rushing water, but they are easily rebuilt and serve a most useful purpose.



TEMPORARY STREAM CROSSING ON MISSOURI ROAD

Soundings Made by Driving Rails to Bedrock at Pueblo

By E. W. Lane
Assistant Engineer, Pueblo Conservancy District, Pueblo, Colo.

THE recently completed flood prevention work at Pueblo, Colo., consists of a new channel through the city and a retarding basin about seven miles upstream, with the changes in railroads and other public improvements that these constructions necessitated. Due to the high velocity which the water will have at flood stage in this channel, it was necessary to pave the bank with concrete and drive sheetpiling from the bottom of the paving to bedrock where the latter was too deep to carry the pavement down to it.

To determine the depth of the bedrock along the

line of this paving, a length of about two miles, as well as to determine the depth of the rock for the foundations of a number of structures, it was found possible to make a considerable saving by driving old steel rails. For this purpose, a piledriver was mounted on skids and was dragged from place to place, usually by a cable. The leads were 40 ft. long and the motive power was furnished by a Cadillac engine belted to a two-drum hoist, but mounted separately from the driver. This arrangement proved to be satisfactory. A 1,200-lb. hammer was used and a special guide was necessary to hold the rail between the leads.

In all, about 100 rails were driven to an average depth of 28 ft. and a maximum of 38 ft. but there seems to be no reason why this depth could not have been exceeded if necessary. Old 75-lb. rails were used and ordinarily were not recovered. Where the depth was greater than one rail length, a second rail was spliced to the first by bolting a fish plate on one side only; this second rail could be recovered. The piles were driven to refusal under long drops of the hammer. The ground consisted of silt and gravel with cobble stones up to 6 in. in size but there were no large boulders. The bedrock was a hard shale. Excavation showed that the rails had penetrated the shale to a depth of from 6 to 18 in. Except for this difference which could hardly happen with a harder rock, the indications were very reliable.

Including the cost of the rail the average cost per sounding was $30, the greatest expense being the moving of the rig. On account of other factors, it was not possible to move continuously along the line of soundings, thus considerably increasing the cost. Under favorable conditions a rail could be driven in about half an hour. Another half hour was required to move to the next sounding, 100 ft. away. Had a dragline or crane mounted on crawlers been available the cost of the soundings could have been reduced considerably.

Fairly satisfactory soundings were also made to depths as great as 20 ft. with 1 to 1½-in. drill rods driven with a maul. For greater depths the rods were found to be too limber.

The engineering for the Pueblo Conservancy District was done by the Dayton Morgan Engineering Co. for which Barton M. Jones was resident engineer and A. H. McGregor in direct charge of the rail driving work.

Center Bearing Disk for Swing Spans Has Novel Features

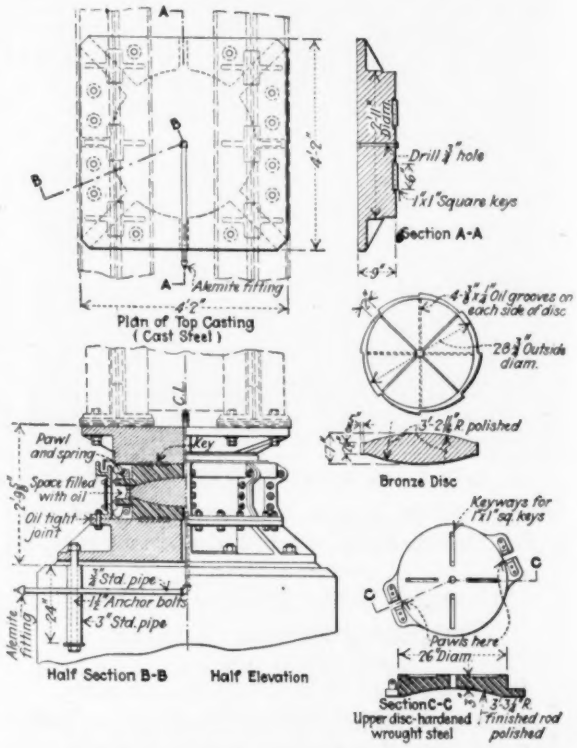
A BRONZE center bearing disk, designed by the Washington State Highway Department for use on swing bridge spans, has novel features in the provision for rotation and lubrication. The attention of the bridge department was directed toward this detail by the fact that the ease of operation, and in consequence the cost of power, for opening and closing swing spans is greatly influenced by the ease and smoothness with which the main center bearing works. This stressed the importance of lubrication and details were worked out for an Alemite pressure lubricating system in connection with a bronze bearing disk turning between hardened tool-steel foot blocks. The arrangement is such that when the span is opened rotation is on the upper surface of the disk and when the span is closed, on the lower surface.

From Job and Office

Hints that Cut Cost and Time

An important feature of this design is that rotation is continuous in one direction, thus making sure that the lubrication is efficient. Four oil grooves, 90 deg. apart, are used on both faces of the bronze disk and thus with complete rotation there is assurance that the entire bearing surface is lubricated as often as complete rotation occurs, regardless of the path of egress followed by the injected oil.

With this arrangement there is no danger that one



DETAILS OF DISK AND CASTINGS FOR SWING SPAN CENTER BEARING

surface of the disk may become better lubricated than the other so that rotation on the poorly lubricated side ceases and the bridge swings back and forth through 90 deg. on one side of the disk only.

To limit the rotation to one direction, pawls on the upper and lower castings engage teeth on the circumference of the disk. When the bridge opens a pawl on the casting above the disk engages a tooth on the disk and carries it around in the direction of bridge rotation 90 deg., while when the bridge is closed a pawl on the casting below the disk engages a tooth and holds the disk stationary. The pawls are operated by simple leaf springs and are completely immersed in oil. Hand holes are provided in the housing so that they may be examined when necessary.

This detail was developed under the direction of Charles E. Andrew, bridge engineer, Washington State Highway Department.

From Job and Office

For Contractor and Engineer

Tests of Cement-Asbestos Pipe

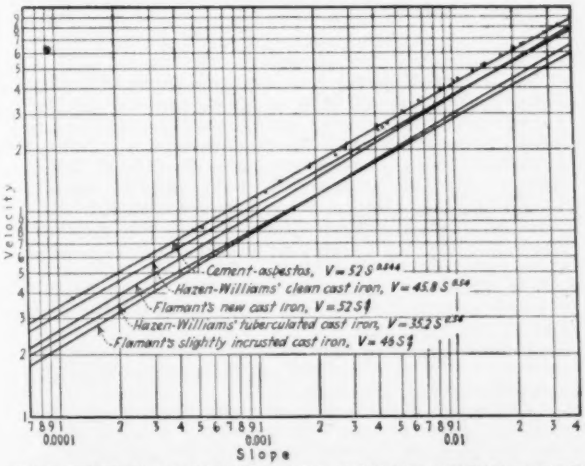
By W. S. Pardoe
Professor of Hydraulic Engineering,
University of Pennsylvania, Philadelphia

THE following is a brief summary of the results of tests conducted by the writer on 150-mm. (5.9-in.) inside diameter, 15-mm. (0.59-in.) thickness pipe constructed of 85 per cent slow-setting portland cement and 15 per cent asbestos fibre.

The bursting pressures varied from 300 to 450 lb. per sq.in., corresponding to tensile stresses of 1,500 to 2,250 lb. per sq.in. This is very high for unreinforced concrete. Tests of the joint gave no leakage prior to bursting which took place at a remote point indicating that the joint is stronger than the straight pipe.

To check the results just stated, specimens were milled from a pipe and gave a longitudinal stress of 1,820 to 2,310 lb. per sq.in. and a transverse stress of 1,810 to 1,930 lb. per sq.in. The stress-strain test gave a secant modulus of 3,500,000 lb. per sq.in.

A 102-lb. tup was dropped from heights of 6, 12, 18 and 24 in. on 4-ft. samples of pipe. Cement asbestos cracked at 18 in. and shattered at 24 in. fall; 6 in. cast iron 0.44 in. thick cracked at 24 in. fall.


Velocity
Slope
Cement-asbestos, V = 52 S^0.544
Hazen-Williams' clean cast iron, V = 45.8 S^0.54
Flamant's new cast iron, V = 52 S^½
Hazen-Williams' tuberculated cast iron, V = 35.2 S^0.54
Flamant's slightly incrusted cast iron, V = 46 S^½

TEST CURVES OF VELOCITY IN CEMENT-ASBESTOS PIPE COMPARED WITH VALUES FOR CAST-IRON PIPE

Due to the method of manufacture the interior of this pipe is as smooth as marble and the discharging capacity is greater than cast-iron pipe of the same size. The accompanying log-log curve gives the equation $V = 52\ S^{.544}$ and also shows values for cast-iron pipe by the Hazen-Williams and Flamant formulas.

If the cement asbestos discharge from $s = 0.0005$ to $s = 0.04$ be taken as 100 per cent then Hazen-Williams not tuberculated equals 89 per cent and tuberculated equals 68 per cent; Flamant new, 86.5 per cent and slightly incrusted, 70.2 per cent; Hamilton Smith for clean cast-iron 87 per cent. The average value of Kutter's n is 0.0091. These figures indicate that the cement asbestos pipe will discharge 15 per cent more than clean cast-iron and 45 per cent more than slightly tuberculated cast-iron pipe.

The samples tested were straight cylinders 4 m. (13.1 ft.) long and weighed 10 lb. per ft., or about one-third of the weight of cast iron for the same service. The joint consists of a sleeve, two rubber rings about ⅜ in. square and two cast-iron collars pulled together by three ⅜-in. bolts in the form of a double stuffing box. The material can be cut with a hack saw, machined in a lathe, drilled and tapped for corporation cocks. For permanent work a strengthening collar is used.

The desirable characteristics of this pipe should appeal to water-works men. It is not subject to tuberculation, and hence maintains its discharging capacity. It is a non-conductor and is hence not subject to electrolysis. It is very light with correspondingly low freight charges. It is easily laid and taken up by common labor. It is cheaper than cast iron.

The pipe is manufactured in Genoa, Italy, on an ordinary cylinder paper machine by building up layers of cement asbestos about 0.2 mm. in thickness on a mandrel under constant pressure.

Job and Office Notes

Land monuments, situated on areas that are being graded, have been preserved in their original position by a unique method, as described by S. P. Baird, engineer and contractor, Columbus, Ohio. A hole was excavated to the required depth, with a post hole digger. One-foot lengths of ¾-in. pipe were strung on a ¾-in. rod, and the rod and pipe were placed in the hole and set in exact position. The hole was backfilled with soil to which some lime had been added in order to change its color. After the backfilling was completed, the rod was withdrawn; this left a series of pipes, each 1 ft. long standing one on top of the other. The grading operations were then started and carried on without reference to the pipe. Each 1-ft. section was carried away in the grading operations, leaving the next section below undisturbed; the spot was readily located by the lime.

Engineers Who Have Had Occasion to use cast-iron pipe welded with either cast iron or bronze will be interested in the results of an investigation made by A. R. Lytle, of the Union Carbide and Carbon Research Laboratories, Inc., Long Island City, N. Y., and announced at the International Acetylene Association convention, Chicago, Nov. 18. In his paper "Effect of Heat of Bronze Welding on Cast-Iron Pipe," Mr. Lytle enunciated the following conclusions: 1—Neither cast-iron welding nor bronze-welding has any detrimental effect on the structure of cast-iron pipe; 2—it is possible that with cast iron very high in phosphorus, the bronze-welding may weaken the structure sufficiently to lead to failure, though this is doubtful; 3—inasmuch as both welding with cast iron or with bronze strengthen the base metal at that point, it is more or less natural that line failures in overstressed pipe should occur just outside these altered zones; and 4—it may well be that some of the failures occurring in welded gas lines have been the result of surface cracks or defects in the pipe. The influence of these cracks may be emphasized by the welding process.

"Follow Up Work of Maintenance Crews is becoming more and more important as the snow removal on rural highways is becoming more extensive," writes Creighton D. Bickley, construction engineer, North Caldwell, N. J. "Of this post-storm work the first thought should be drainage. The removal of water accumulated between windrows must be done promptly to avoid disastrous conditions in case of a freeze-up. To expedite and facilitate this work markers are placed in the immediate vicinity of the entrances and outlets of culverts, but in no case in such a location that they might obstruct the flow. These markers consist of pieces of 1 x 2-in. furring lath 4 to 8 ft. long. One end of each stick is dipped into bright red paint for a distance of about 1 ft. The other end is pointed and driven securely into the ground. The maintenance crew in following up the snow-moving equipment readily see the red tops of the markers against the white background of snow.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Workability of Diatomaceous Concrete

Sir—Referring to an article by C. N. Conner in your Dec. 17 issue, in which Mr. Conner claims that a diatomaceous earth known as celite increases the strength of concrete, it would be very interesting to know more about how these test were carried out. Mr. Conner states: "All laboratory tests were made on concrete of equal consistencies. The increased workability of the concrete, when celite is used, permits the use of dryer consistencies in field concrete."

How was this increased workability measured? Professor Abrams' very extensive tests on various admixtures were not favorable and some recent tests with which the writer is acquainted, though not made with celite, were also unfavorable. These tests showed an *increase* in strength but also a *decrease* in the slump. The same or a greater increase in strength could be had by decreasing the mixing water and leaving out the admixture; the slump being the same in both cases.

B. F. JAKOBSEN,
Engineer in Charge of Dams.

San Fernando, Calif.,
Dec. 30, 1925.

T-Branches for Sewer Connections

Sir—The letter from Alexander Potter published on p. 1043 of your issue of Dec. 24, 1925, entitled "T-Branches Rather Than Ys for Sanitary Sewer Connections," is prefaced by the assertion that the recently adopted Rules and Regulations of the New Jersey State Department of Health preclude the use of T-Branches on sanitary sewers. We would like to know where in the rules Mr. Potter finds anything that warrants such a conclusion.

H. B. COSTILL, M.D.,
Director New Jersey Department of Health.

Trenton, N. J.,
Dec. 28, 1925.

Sir—On receipt of a copy of the foregoing letter by Dr. Costill I reread the printed rules and regulations in question and was non-plussed to find they contained no reference to the use of branches. I regret the error.

In fairness to myself, however, I must state that at the time of the receipt of the printed rules and regulations, I also received a copy of a letter from Dr. Costill under date of Oct. 7, addressed to the engineer of a New Jersey municipality, by which I am retained as consulting engineer, containing the following definite statement: "The specifications are not clear as to whether all house connections are to have T fittings where they enter the main sewer. House connections should have Y connections except in special cases, this to be included in the specification."

In preparing my communication to *Engineering News-Record* a considerable time later, I overlooked the precise source of the statement regarding the use of Y-branches, inadvertently assigning its source to the rules of the Department of Health instead of the official letter of Dr. Costill, director of the Department of Health.

It was my intention to develop a general discussion upon this topic and my reference to the Department of Health of the State of New Jersey was purely incidental. In view of the fact that the rules and regulations recently promulgated by the New Jersey Department of Health had evidences of being so carefully studied and clearly stated I made reference to them as an authority advocating the use of Ys in preference to Ts. Dr. Costill is not alone in his opinion regarding superiority of Y branches and I trust that this subject may be discussed.

ALEXANDER POTTER,
Consulting Engineer.

New York,
Dec. 31, 1925.

T Sewer Junctions Preferred by Manufacturers

Sir—The Sales and Engineering Departments of this company named below have read with interest the letters by Alexander Potter and A. G. Dalzell in your issues of Dec. 24, 1925, p. 1043, and of Jan. 7, p. 34, on the substitution of T branches for Y branches in sewers.

From a manufacturing and merchandising point of view, we can readily confirm Mr. Dalzell's statement that T junctions are produced at lower cost than Y junctions. Not only are the manufacturing operations greatly simplified in the case of the right-angle fitting, but the losses in drying, burning, handling and shipping are materially less.

Another important factor is the cost of stocking both T and Y fittings in the numerous combinations that the trade demands. Owing to the time required to make fittings, a large stock of each size is required, and it frequently happens that orders will, for a period of time, call mainly for one style of fitting, with the result that the other is temporarily a dead stock item.

Sewer pipe manufacturers, in accordance with suggestions by the Department of Commerce, are striving diligently to standardize specifications and sizes of pipe and kindred ware for the benefit of both the consumer and themselves. In our opinion, it would be a further valuable move in this direction were the Y branch to be eliminated. Such a move must, of course, originate with the engineers who design sewers and specify the fittings.

Some Y fittings may be desirable in the smaller sizes where the converging flow feature is more significant, and in such cases the T fitting can probably be omitted.

We believe our customers could be served more promptly and at lower cost by a reduction in the variety of fittings, the elimination of Ys where possible, and the elimination of Ts where Ys must be retained. We further feel that a thorough discussion of this subject through your paper will bring some very beneficial results.

FOSTER HOLMES,
General Manager, Evans & Howard Fire Brick Co.

St. Louis, Mo.
Jan. 14, 1926.

Use of Long Tapes

Sir — Regarding the use of long tapes (*Engineering News-Record*, Dec. 24, 1925, p. 1024), tapes of 200 and 500 ft. are in constant use at the present time in the location surveys now being made for the International Railways of Central America in the mountainous districts of Guatemala where many deep barancas or ravines must be crossed. A tape 100 ft. is also used even on the steepest mountain sides, as stakes are always placed at each station for taking levels preparatory to making profiles and as a base for cross-sectioning the line.

The writer was often surprised how closely to the calculated distance the chainmen (Indians) could measure with the 100-ft. tape although the climbing down and up the steep sides was often very difficult. The 500-ft. tapes used were so heavy that usually an Indian was designated to carry them as his sole duty.

Long tapes have been in use for very many years in engineer corps of the Philadelphia & Reading Coal and Iron Co. in the anthracite regions of Pennsylvania.

Walter Church, elder brother of Benjamin Church, first chief engineer of the Croton Aqueduct, when engineer for the Alliance Coal Mining Co. while at Pottsville, Pa., had great difficulty in securing a length of 200 ft. of hoop-skirt wire to make a tape, as none of that length was on the market—the manufacturer of the flat wire fearing infringement of his patent then existing. Before that a round copper wire had been used. Short sticks for handles were used in pulling the wire taut, one with the wire twisted around at one end and another near the other end as found necessary—the exact place would be marked on the wire or measured from the handle. The wire was then brought to the surface, if the measurement had been made inside the mine, down a slope, or shaft, a comparatively level and clean place chosen and the taper or wire subjected to the same tension and the distance measured with the steel tape, usually 50 ft. long and of English make.

The writer has many times fastened two 100-ft. tapes end to end and stretched over otherwise inaccessible places or places which it was not advantageous to cross, such as rivers, marshes and valuable crops or gardens.

WALTER ASHER.

Baltimore, Md.,
Jan. 1, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Am. Soc. C. E. Holds 73rd Annual Meeting

Action on Proposed Amendments—Day Devoted to Division Sessions—Entertainment Features

Approximately 1,000 members attended the 73rd annual meeting of the American Society of Civil Engineers, held in the Engineering Societies Building, New York, N. Y., Jan. 20-22. During Wednesday morning, Jan. 20, the society's medals and prizes were awarded and honorary membership was conferred upon William Barclay Parsons and Arthur N. Talbot, as reported in these pages last week. At the close of the Wednesday morning session, action was taken upon several proposed amendments to the constitution.

Amendments Passed

A proposed amendment was passed whereby graduation from a school of engineering of recognized reputation shall be considered as equivalent to four years instead of two years of active practice and the satisfactory completion each year of work in such school without graduation shall be considered as equivalent to a half year of active practice; another proposed amendment that passed requires that junior membership must have as a prerequisite four years instead of two years of active practice in some branch of engineering, or graduation from a school of engineering of recognized standing. These two amendments will now be referred to the membership for action by letter ballot. Two proposed amendments relating to admission and expulsions were also passed on to the membership to be voted on by letter ballot after apparent inconsistencies in the proposed amendment as printed were corrected by an amendment proposed on the floor of the convention. Several proposed amendments relating to nomination and election of officers, being mutually conflicting, will be referred to a committee composed of the 18 directors for study and recommendation as to final action by the corporate members of the society at the next general session probably.

Wednesday afternoon was given over to the presentation and discussion of reports of the following special committees: Concrete, reinforced-concrete arches, flood-protection data, stresses in structural steel, steel column research, impacts in highway bridges, cement, standard construction contracts, irrigation hydraulics, arbitration, engineering contract bonding, electrification of steam railways, stresses in railroad track, codification of present practice on bearing value of soils for foundations, bridge design and construction, hydraulics phenomena, and effects of earthquakes on engineering structures.

(*Concluded on p. 173*)

Engineering Fifty Years Ago

From *Engineering News*, January, 1876

Royal Albert Bridge

THE preliminary plans of this structure, which is to span the St. Lawrence River at Montreal, are being rapidly reduced to order so as to be presented to a meeting of New England and Western, and Canadian Railway men which will be called during the month of January ensuing, to take into consideration the means to be adopted for establishing the financial basis of the undertaking.

The Dominion Government is building a railway from the mouth of French River, Georgian Bay, Lake Huron to the Ottawa River at Ottawa City, at which point it unites with the Quebec, Montreal, Ottawa and Occidental Railway, now being built by the Quebec Province. The Royal Albert Bridge is to connect these railways with the American system to the south.

It is also proposed to build the Ontario and Quebec Line from Ottawa City to Toronto passing through the central part of Ontario, at Toronto meeting with the Great Western and its western connections, and at Ottawa City with the Q. M. O. and Occidental, and so over the Royal Albert Bridge to Portland, Boston, New York and other points now reached only over the G. T. R., thus forming an independent and competition line to this latter railway.

The importance of this great undertaking is thus to be seen, and we will in future numbers of *Engineering News* endeavor to show the railway system of the Dominion and its connections, and the important position that the Royal Albert Bridge occupies in connection with it.

Charles Legge, C. E., of Montreal, is the Engineer of the proposed bridge.

Exhibition of Hydraulic Power to Be Held at Basle

An international exhibition for inland navigation and utilization of hydraulic power is to be held in Basle, Switzerland, July to September, 1926. The first sectional conference of the World Power Conference will also be held at Basle during the time of the exhibition.

Water Conservation Before Drainage Congress

Interstate Questions in Water Rights Floods and Drainage—Federal Surveys Held Important

Arkansas River flood control and water storage and use was chief of the various problems discussed by the National Drainage Congress at its fourteenth meeting, held at Oklahoma City on Jan. 18-20. The Farmers Union of Oklahoma held its annual convention at the same time, and a conference of Arkansas River states on division of water rights also was in session in Oklahoma City, dealing with matters closely related to those before the Congress.

Many States Represented

Eighteen states were represented, with 157 delegates. Resolutions were passed endorsing the Arkansas River flood control project, inland navigation, conservation of wild life, plant life, and soil fertility, the Temple Bill for topographic mapping, the Newton Bill for a water resources survey, and other matters. Roy N. Towl, of Omaha, was elected president for the next year. The new vice-presidents are W. A. Strong, of Boise City, Okla., F. A. Tomson, of Lincoln, Neb., and A. J. Bracken, of Chicago.

Flood Control Problems

Several reviews of the Arkansas River flood control project were presented, considering both the Arkansas River basin as a whole and the Canadian River basin, for which a detailed flood control project has been under study during the past year. Flood control along the Arkansas has been advanced during the past year by the completion of the Pueblo protection work, and beginning of work on the protection plan of Wichita, an undertaking which will cost nearly $900,000. It was brought out that the North Canadian project, providing for a flood control district about 2 miles wide and running through 18 counties of Oklahoma, is planned as a benefit assessment district, under which only about one-fourth of the cost will fall on agricultural lands. Many flood basins are available, 24 having being surveyed west of Oklahoma City and 14 east of that point, with a total storage capable of absorbing the 1923 flood at peak flow for four days. The impounded water will be capable of utilization for irrigation. Before the Arkansas can be dealt with as a whole, agreements between the states concerned must be formulated as to the disposition of interstate waters to avoid future litigation. A number of such agreements have already been concluded and frequent meetings are held at the various state capitals for further work.

Among the other points developed at the congress, the following specific items are noted:

Speaking of swamp-land drainage, Raphael Zon, of the Forest Service, stated that partial drainage of swamp timberland materially increases forest growth. Federal co-operation in large-scale drainage and flood conservation work was reviewed by A. D. Jackson, secretary of the Brazos River Reclamation Association, who said that 20,000,000 acres of land in Texas are in need of flood protection, drainage, or low-cost irrigation. To make this work possible and effective there must be federal co-operation in the way of guidance, information, and sanction and approval of securities, he said.

The importance of interstate discussions to forestall litigation was brought out forcibly by Prof. E. F. Chandler, University of North Dakota, who illustrated his argument by reference to the drainage suit between the Dakotas and Minnesota. N. C. Grover, of the U. S. Geological Survey, discussed the value of federal studies of water resources; the Newton Bill, now before Congress as the result of an insistent demand of state officials for federal study of water, authorizes the expenditure of $500,000 a year for 20 years. C. E. Jacoby, Kansas City, reviewed the development of navigation on the Missouri River and advocated improvement of the river and other inland waterways for navigation. W. G. Potter, of the state waterways division of Illinois described plans developed for flood protection of Freeport, in that state, an undertaking likely to cost about $750,000.

Arkansas River Control

Contributions to discussion of Arkansas River basin flood control and water conservation matters were made also by A. S. Stinnett, of Texas, C. A. Bock, of Pueblo, Colo., and A. W. Large, of the Rock Island Lines. Mr. Stinnett outlined some of the problems presented by the South Canadian, where planning for water conservation is rendered especially difficult by the virtual absence of usable data on average runoff. Mr. Bock, after sketching the results of the Pueblo flood protection work, said of comprehensive regulation of flow in the Arkansas Valley, "It is entirely possible that a comprehensive plan will be worked out for the control and regulation of flow in the Arkansas Valley that will ameliorate flood conditions and at the same time conserve portions of the flood runoff for irrigation purposes at a cost that would not be prohibitive." Mr. Large indicated that the Rock Island system has studied development of the Arkansas River basin for many years, and expressed the opinion that a comprehensive solution of the conservation and development problem for the basin is possible, at very moderate cost.

Farm drainage was one of the important topics of the presidential address, delivered by E. V. Willard. He said that the most fertile field for drainage operation is in the reclamation of swamp and wet areas within occupied farms. He urged extension of tile drainage, but mainly in small sizes, with dependence on ditches for larger capacities. "We need more little tile and less big tile," he said.

Bearing on the irrigation and development problems associated with the conservancy projects discussed before the congress, G. C. Kreutzer, of the Bureau of Reclamation, talked on settlement and farm development problems, which he described as the chief economic problems of irrigation development.

George A. Walkem Elected Head of Canadian Institute

George A. Walkem, consulting engineer, Vancouver, B. C., who was elected president of the Engineering Institute of Canada at its annual meeting now in session at Toronto, Ont., is a native of Kingston, Ontario, and a graduate

George A. Walkem

from the faculty of applied science, McGill University in 1896. Previous to graduation he was apprenticed to the machinist trade with the Kingston Locomotive & Engine Company and the Kingston Foundry. From 1900 to 1906 he served as works manager, Vancouver Engineering Works, Ltd., and from 1906 to date as managing director, Vancouver Machinery Depot, Ltd. Also, he is a member of the British Columbia legislature for the constituency of Richmond-Point Grey. During the war Mr. Walkem served with the Royal Engineers in Palestine from 1916 until 1919. In December of this year he was elected president of the Association of Professional Engineers of British Columbia.

Commercial Club to Make Port Plan for Chicago

Embarrassed financially for money for investigation and research of an adequate port plan for Chicago, Mayor Dever has asked the Commercial Club of Chicago to undertake the task. That organization, which produced the Chicago Plan under the late D. H. Burnham, has accepted the commission and will expend $50,000 or more in a survey and study of conditions to give Chicago a complete lake and waterways port. Not until such a plan has been adopted providing for shipping other than in the Chicago River will the War Department give permits for fixed bridges.

Abutment of Dam Fails Through Undermining

New Arch Dam at Tryon, N. C., Partly Destroyed by Undermining of One Abutment

The western abutment of a new concrete arch dam on Vaughn Creek at Tryon, N. C., was undermined and overturned during the morning of Jan. 21. Water from the reservoir behind the dam washed out a 60-ft. steel highway bridge a few hundred yards below the dam and three lower bents of a three deck timber trestle on the Southern Railway line from Spartanburg, S. C., to Asheville, N. C., which is situated about ½ mile below the dam. The dam is a constant radius arch type structure 62½ ft. high and 300 ft. long, 12½ ft. thick at the bottom and 1 ft. thick at the crest, battered on both sides. It is supported at both ends by earth-filled gravity-section abutments. The dam was built recently by the Tryon Development Co. to form Lake Lanier, a lake having an area of 120 acres, as part of a real estate development. The reservoir had just been filled for the first time and it is reported that there had been some seepage through the western abutment during the process of filling. Eye witnesses of the failure state that just before it occurred, water began to appear about half way up the bank at the west abutment, that soon afterward cracks appeared in the concrete and the whole abutment and part of the bank washed out. The exposed portion of the bank has the appearance of being made up of earth and soft shattered rock ledges.

George Kershaw, the engineer who designed the dam, states: "Western gravity section which failed was 16 ft. wide, 30 ft. high at the highest point, built on a concrete mat, 3 ft. thick, laid on hard conglomerate with cutoff wall 5 ft. deep on upper side. This abutment undermined by water and foundation settled overturning section. Remainder of dam intact."

Transit Plan for New Jersey Submitted to Legislature

Plans for a rapid transit loop approximately 17 miles long to provide direct connection between the railroads in New Jersey and the city of New York have been submitted to the New Jersey Legislature by the North Jersey Transit Commission. This loop is to form the nucleus around which a larger system can be built in the future. It will extend from a connection with the Erie R.R. on the Hackensack Meadows in New Jersey southward to the Jersey Central R.R. terminal in Jersey City, thence by tunnels under the Hudson River to Manhattan Island at the Battery. From this point the line will extend north in subway under Lafayette St. and Lexington Ave. to 57th St. where it will turn west across the island and under the Hudson River back to the point of origin. Alternate proposals call for a connection with the Interborough Subway at the Battery or with the Hudson & Manhattan Tubes, with operation of the loop by either company.

Contractors Discuss Day Labor and Government in Business

Engineering News-Record Staff Report

The Seventh Annual Convention of the Associated General Contractors held at Portland, Ore., last week carried through a crowded schedule although doing so required an extra session. The three big issues before the convention were day labor work, the surety bond situation and government in business. High lights of the convention in these matters were first, the announcement of a report on the day labor situation adopted by the United States Chamber of Commerce which strongly favored the contract method. Second, after vigorous discussion unanimous approval of the surety bond committee report and third, general missionary work in interesting the public in getting the government out of business. The selection of officers for 1926 was as follows: President, J. H. Ellison, Minneapolis; vice-president at large, Natt McDougall, Portland, Ore.; vice-president, George Watson, Dallas, Tex. The following were named as directors: James E. Cashman, Burlington, Vt.; Walter H. Gahagan, Brooklyn; D. B. Fegles, Minneapolis; Robert J. Potts, Waco, Tex.; J. W. Mann, Oklahoma City, Okla.; H. W. Baum, Salt Lake City, and F. J. Twaits, Los Angeles. The new chairman of the highway division is R. C. Jacobs, Philadelphia, and of the railway and public works division W. M. List, Kansas City.

The convention registration was 548 of which about 300 were members and 200 ladies and guests. A more complete report will be given in next week's issue.

Street Sanitation Officials Meet in Chicago

With about fifty municipal officials having to do with street cleaning in attendance the International Association of Street Sanitation Officials Jan. 11 and 12 held in Chicago their most successful meeting. This organization, headed continuously up to this year by W. J. Galligan, has maintained the round table conference form, a dozen topics being chosen for discussion and each city representative in turn giving his experience on the subject. By resolution the newly elected officers were requested to prepare a statement with reference to salaries of officials, semi-officials and employees to be sent to mayors and finance heads. A few of the superintendents protested that the matter was entirely a personal one and they preferred not to have their superiors receive what might be interpreted as an indirect request for an increase in salary. Incidentally that is the very reason for the resolution.

Chicago's street cleaning department is one-third motorized and has saved $300,000 in the last two years according to Thomas F. Byrnes, superintendent of streets. More money cannot be obtained for street sanitation so that greater efficiency and more work can only be obtained by the use of modern machinery and methods. Many cities are coming to night collections for congested districts because of the traffic interference with the men and equipment during the day. For details of the costs of collection of refuse in Chicago by tractors and trailers see an article in *Engineering News-Record*, Jan. 7, p. 27, by Mr. Galligan.

Street cleaning methods were outlined in detail indicating an increasing use of pick-up machines and more attention being paid to keeping unit costs. B. C. Harvey, Rockford, went especially into the complete cost account system described in *Engineering News-Record* Nov. 19, 1925, p. 842.

Parking is the greatest problem before city governments today was the general opinion.

Officers elected for the ensuing year are as follows: President, Theodore Eichhorn; vice-presidents, T. H. Byrnes, Goline Doremus and A. B. Cook; treasurer, A. J. Paul. A. M. Anderson, Chicago, was re-elected secretary.

Michigan Engineers' Conference

Airships, airplanes and air transport are to be prominent subjects at the Michigan engineering conference at Detroit, Feb. 4 and 5, at which practically all technical organizations in the state will be represented. Some of the items on the program are as follows: "Regulation of the Great Lakes," John R. Freeman; "Aircraft Engineering Progress," C. F. Kettering, Carl B. Fritsche and Wm. B. Stout; "Stream Pollution," Harrison P. Eddy; "Building Codes," Frank Burton; "Engineering Organization for Public Service," L. W Wallace; "Reciprocity and other Engineering Registration Questions," John J. Cox; "Air Transport," William B. Mayo, Paul Henderson and Howard E. Coffin.

Ohio Engineers' Program

For the annual meeting of the Ohio Engineering Society at Columbus, O., Feb. 4 and 5, the tentative program includes the following papers. In each case the second speaker is to open the discussion: (1) "The Pittsburgh Stadium," W. C. Hindman, designing engineer of bridges, Ohio Highway Department; Prof. C. T. Morris, Ohio State University; (2) "Theory of Concrete Proportioning," Prof. J. R. Shank; C. B. Cornell, construction engineer of Columbus bureau of water works extension; (3) "Recent Developments in Highway Bridges," J. R. Burkey, chief bridge engineer, Ohio Highway Department; G. R. Logue, deputy county surveyor, Columbus; (4) "Subsoil Investigation," Prof. F. H. Eno; Atlee M. Wise, county surveyor, Canton, O.; (5) "Progress in Sanitary Engineering," G. B. Gascoigne, consulting sanitary engineer, Cleveland; E. G. Bradbury, Franklin County sanitary engineer, Columbus; (6) "Salvaging Old Pavements," A. H. Hinkle, chief maintenance engineer, Indiana Highway Commission; John Gallier, deputy county surveyor, Toledo, Ohio. The president is G. F. Schlesinger and the secretary, Carl L. Van Voorhis, both of Columbus, Ohio.

Am.Soc.C.E. Holds 73rd Annual Meeting

(*Concluded from p. 171*)

The entire day of Jan. 21 was given over to meetings of the technical divisions. Three of these, structural, highway and city planning, were held in the Engineering Societies Building, and the other four, sanitary engineering, power, waterways, and construction, in the Hotel Pennsylvania. As reported in last week's issue, a new technical division, on surveying and mapping, was authorized. Only a small percentage of those enrolled in the various divisions attended the technical sessions of them.

Special Features

Entertainment features included a smoker Thursday night, at which time there was presented a three-act play, which purported to represent the vicissitudes of a consulting engineer who ultimately finds economic necessity a stronger factor than professional ethics. On Friday, about 400 members visited the Central Railroad of New Jersey bridge across Newark Bay, returning in time for luncheon in the Holland Tunnel under the North River. Tables were spread in the tunnel itself and approximately 500 members and guests were fed, after which an inspection of a portion of both the north and south tunnels was made. Before the inspection, however, at the suggestion of President Davison, messages were extended to Mrs. Clifford M. Holland and Mrs. Milton H. Freeman. Mr. Holland, for whom the tubes are named, was the first chief engineer, and he died late in 1924. Mr. Freeman, who succeeded him, died several months after. On Friday night there were the usual college and alumni dinners. The annual dinner of the sanitary engineering division was held Tuesday night, Jan. 19, and that division also held a joint meeting with the New York section of the American Water-Works Association on Thursday, Jan. 21.

The committee on the Alfred Nobel Memorial again reported that its funds fell far short of the $100,000 with which a memorial was to be erected. Last year it recommended return of this money to the United Engineering Society for reinvestment, but the committee was continued. The secretary reported that the annual scholarship to Columbia College was still available.

Society Finances

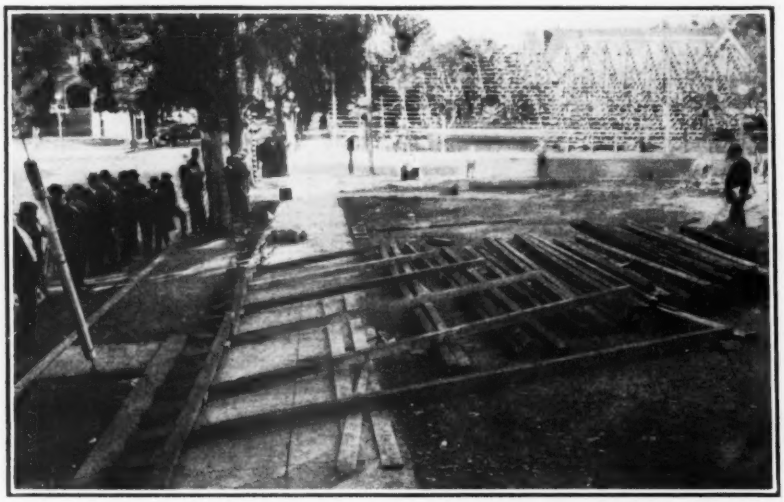
The finances of the society are in good condition. There has been paid $40,000 more on the mortgage on the 57th St. property. The balance of cash on hand and fluid funds in short-time securities but exclusive of funds held in trust for certain special committees and technical divisions is $97,769 as against $85,704 at the end of 1924. Since the beginning of the year this figure has increased about $12,065. A large element of this increase has been the persistent effort of the executive committee to collect current and past dues.

Reports on the sessions of the special committees and technical division will be found on p. 154 of this issue.

Wrecked Reviewing Stand Found Defective

Pasadena Stand Which Collapsed On Jan. 1 Found Inadequate In Its Design

In a report on the failure of a reviewing stand at Pasadena on Jan. 1, made at the request of R. V. Orbison, city manager, a board of inquiry by majority finding states that the reviewing stand was "totally inadequate and insufficient" in design, that it was not in conformity with the city ordinance, that it was built of poor material and with poor workmanship, and that the stand was totally unsafe for service.



RECONSTRUCTED BENT OF COLLAPSED REVIEWING STAND

The failure is directly attributed to insufficient cross-bracing (from front to back of stand).

The stand was of peculiar design. It was 68 ft. long and 41 ft. wide front to back and about 20 ft. high at the rear, accommodating 22 rows of seats intended for 43 persons per row. The seat planks and foot boards rested on step framing built on top of inclined stringers running from front to back of stand. These stringers, spaced about 7½ ft., were 2x6 Oregon pine planks on edge, each held up by eight 4x4 posts, spaced 4 to 6 ft. and by the bearing of the front end of the stringer on a short piece of plank laid on the ground. The posts were not vertical, but were inclined 8 or 9 deg. from the vertical, the upper end leaning toward the front of the stand. Their upper ends were beveled so that the stringers would seat on them directly, and each stringer was fastened by toenailing with 10-penny box nails and by a 3x1-in. scab 8 in. long nailed on one side. Directly back of the post an anchor block was nailed to the bottom of the stringer. Each post rested on a mud sill of 2-in. plank, but the lower end of the post was not bevel-cut to seat horizontally on this plank but was cut square so that it rested on the plank only on its front edge, except that in some cases a small heel block was nailed to the mud sill under the rear edge of the post. Just back of the post an anchor block was nailed to the mud sill, but this was omitted in some cases. The lower ends of the posts were in most instances tied together (from front to back of stand) by a 1x6 board nailed to their sides, extending forward to the lower end of the stringer and nailed to it. There was no other bracing in the front-to-back direction lengthwise of the stand, the report says, there was a hit-and-miss attempt at cross-bracing, leaving many posts unbraced throughout their entire length.

The material in the reviewing stand was largely second-hand and second grade or poorer, was very brash and full of knots, and was in part second-hand concrete form lumber. Several of the posts had many bolt holes in both directions through them. The workmanship was also of very poor quality.

It is held that this design violated the requirements of the city building ordinance which requires every reviewing stand to be built so as "to withstand a live-load of not less than 125 lb. per square foot with a factor of safety of 4" and to be braced against all possible diagonal strain. The report computes the forward push at the lower end of the seat stringer as about 3,000 lb. per stringer under the load prescribed by the ordinances, or about 1,330 lb. under the load actually on the stand at the time. The latter load would produce a pressure against the 2x4 stakes driven into the ground to hold the front of the stringer mud sill of about 900 lb. per stake, while the stakes were estimated to be good for a safe load of about 200 lb.

It is held that the stand failed through pushing forward the mud sill and stakes at the lower or front end of the seat stringers. The pivoting of the inclined posts after the stringer started to slide forward left part of the stringer unsupported and caused the stringer to break at the splice at mid-length, allowing the rear section to telescope over the forward.

The view herewith shows one of the failed bents reconstructed by the committee.

The report was made by Edward L. Mayberry and L. A. Parker, of a board of three appointed by the city manager.

Water Men and Sanitary Engineers Have Joint Lunch Meeting

As was done a year ago, the New York Section of the American Water Works Association arranged again this year to hold one of its winter luncheons on such a date that it could be attended by the members of the sanitary engineering division of the American Society of Civil Engineers during the winter meeting. This took place on Thursday, Jan. 21. The program was made short as it was sandwiched between the morning and afternoon sessions of the sanitary engineers. A paper by H. M. Beardsley, general manager, Water Board, Elmira, N. Y., described two sudden increases in the color of the city water supply due to tannery wastes, and possibly to mine wastes in addition, discharged into tributaries of the Chemung River. On the second of these occasions it was necessary to shut down the filter plant for a short time. A notable feature of both incidents was the co-operation of the New York and Pennsylvania State Health Departments in dealing with the problem.

Contrasting experiences with incrustation in two old water mains were related by W. W. Brush, deputy chief engineer, Department of Water Supply, New York City. Some uncoated cast-iron pipe laid in Brooklyn in 1857 was shown both on the screen and by way of actual samples of the pipe, together with coated pipe laid in Brooklyn in 1863. The uncoated pipe was largely filled with the results of corrosion and the second or coated pipe was almost as clean as when laid, whereas much pipe which had been in the ground only a few years is badly incrusted. Mr. Brush thought that the remarkably good condition of the 60-year old coated pipe was due to the high quality of the coating. He stated that New York City now spends some $5,000,000 a year for cast-iron pipe which by the end of ten years had lost some 40 per cent of its carrying capacity.

Charles W. Sherman, of Metcalf & Eddy, Boston, Mass., said that he had recently been giving much attention to his general subject and that his present opinion favors lining cast-iron pipe with cement. Subsequently, Mr. Brush said that his mind was following along the same general line. He also suggested the desirability of cleaning tuberculated water mains and of recoating the interiors of the larger of these. At the same time he raised the question as to what means could be devised for recoating the smaller pipe after they had been cleaned.

Concrete Poured at Rapid Rate on Exchequer Dam

Up to Jan. 10, 1926, the concrete pouring records on the Exchequer dam in California showed that 335,000 cu.yd. had been placed in 335 pouring days, of which 189 were single shifts and 146 were double-shift days (8 hr. per shift). The concrete yardage included power house, parapets, roadway, arches, spillways, as well as mass concrete in the dam.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill.; Annual Meeting, Cleveland, Ohio, Jan. 26-28, 1926.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Toronto, Ont., Jan. 27-29, 1926.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 9-11, 1926.

The Kentucky-Tennessee section of the American Water Works Association at its first meeting Jan. 13 to 15 in Louisville elected the following officers: Chairman, Carl E. Davis; vice-chairman, W. S. Patton; and secretary-treasurer, F. C. Dugan, director Bureau of Sanitary Engineering, Kentucky State Board of Health, Louisville. Papers dealt with relations of water-works officials to health officers, rating schedules and filtration problems.

The Western Society of Engineers' Jan. 25 meeting was arranged by the Junior Engineers and devoted to short addresses by older men on the engineer's education after he leaves school. On Feb. 1 the schedule calls for a discussion of the Sanitary District of Chicago by E. J. Kelly, chief engineer, and Langdon Pearse, sanitary engineer. On Feb. 15 Ralph Modjeski will present a paper on "Construction Features of the Delaware River Bridge" and Feb. 23 John E. Hatt, of E. I. duPont de Nemours & Co., will speak on "Explosives in Industry."

The Wisconsin Engineering Society, in a preliminary program of the meeting of Feb. 18, 19 and 20, states that a dozen phases of engineering will be taken up. They include materials of construction, plans and specifications of street plans, regional planning, traffic in main street entrances to small cities, what the motor bus is doing to the street railways, mapping, geology and runoff, financing problems of a city manager, water-works and sewage problems of cities and paper mills, garbage collection and the design and location of gasoline filling stations, a round table discussion and committee reports on drainage, surveying and public utilities. Leonard S. Smith, Madison, is secretary.

Water Works Officials of Colorado, Wyoming and New Mexico, are to hold a conference Feb. 23 and 24 in Denver to discuss mutual problems of the Intermountain District. The question of forming a section of the American Water Works Association will come up. Board of Health engineers and the Mountain States Inspection Bureau are co-operating with the water-works officials. Papers scheduled relate to watershed sanitation, design and maintenance of distribution systems, bookkeeping methods, water supply and fire prevention, financing, bacteria and algae, chlorination, the Rocky Ford filters and health board service. Dana E. Kepner, Colorado state sanitary engineer, and W. S. Rathbun, of the Inspection Bureau, have called the meeting.

Personal Notes

H. DEB. PARSONS, consulting engineer, New York City, was elected president of the American Institute of Consulting Engineers, at its meeting January 19. A biographical sketch of Mr. Parsons was given in our issue of Jan. 21, 1926, in connection with the award to him of the Thomas Fitch Rowland Prize.

CARL L. VAN VOORHIS has resigned as the engineer of the Ohio Good Roads Federation and has become chief engineer of the Ohio Crushed Stone Association, with offices in the Hartman Building, Columbus. Aside from the service which he will render for the association to users of crushed stone, chiefly in highway work, Mr. Van Voorhis expects to make extensive studies into the development of the asphaltic macadam road, studying new cross-sections and new methods of construction. Mr. Van Voorhis is secretary and treasurer of the Ohio Engineering Society and was formerly deputy county surveyor of Hancock County and county surveyor of Knox County, Ohio.

State Engineering Society Meetings—Schedules for meetings of engineering societies in some of the states are as follows:

Illinois	Jan. 27-29	Elgin
Iowa	Jan. 27-29	Mason City
Michigan and Detroit	Feb. 4-5	Detroit
Minnesota	Feb. 4-6	St. Paul
Ohio	Feb. 4-5	Columbus
Wisconsin	Feb. 18-20	Madison
Indiana	Feb. 18-19	Indianapolis
Colorado, New Mexico and Wyoming water-works superintendents	Feb. 23-24	Denver, Colo.

W. O. CUDWORTH, formerly division engineer, Canadian Pacific Ry. at Sudbury, Ontario, has been appointed assistant engineer maintenance-of-way, Canadian Pacific Ry., Montreal, P. Q., to succeed R. E. Keough whose resignation was announced in our issue of December 31, 1925. J. M. SILLIMAN, assistant district engineer at North Bay, Ontario, has been appointed division engineer at Sudbury to succeed Mr. Cudworth.

EDGAR D. GILMAN, assistant professor of civil engineering at the University of Cincinnati, has been appointed executive assistant to Colonel C. O. Sherrill, city manager of Cincinnati, Ohio.

HERMAN RETTINGHOUSE, civil engineer, of Sioux Falls, S. D., formerly of the firm of Chenoweth & Rettinghouse, but for the past year in business for himself, is leaving South Dakota to locate in California. Mr. Rettinghouse has just finished work on a large drainage project in Nebraska, including the building of many bridges.

LOUIS N. BEALS, JR., St. Louis, Mo., has been appointed chief engineer of the Building Department for the city of St. Louis, M. C. Emmanuel, the present chief engineer having resigned recently to accept a position with the James Black Masonry & Construction Co. Mr. Beals has been engineer in the building and bridges construction department under the board of Public Service.

Obituary

ALPHONSO B. BOWERS, whose home was in Lynn, Mass., and who was known as the inventor of the hydraulic dredge, died Jan. 24, aged 96 years. Mr. Bowers was born in West Baldwin, Maine, but in his youth went to California, having already built one dam in the East. In California he engaged in engineering, teaching and lecturing. Among his early exploits was dredging in San Francisco harbor. He invented a method of hydraulicking earth down slopes by use of a stream of water in an open flume for use in building levees and dams. He also devised the use of flexibly connected pipes for carrying earth for fills. Litigation on his hydraulic dredge patents began in 1864; he studied law, became his own attorney, and won many infringement suits, the litigation closing in 1897. In 1863 he was made surveyor-general of California and in 1866-67 was in charge of the sale of all state lands. He installed the water-works of Livermore, Calif., and did important surveying and dredging work on both coasts.

MARTIN MURPHY, who before his retirement from active life was prominent in engineering circles in Canada, died at his home in St. Catherines, Ont., Jan. 10 in the 94th year. Mr. Martin was born in Ireland and came to Canada in 1868. In 1870 he became chief engineer of a railway then projected in Nova Scotia and the following year became a bridge contractor upon the Intercolonial Ry. From 1875 to 1905 he served as provincial engineer to the Nova Scotia government, and in 1913 was appointed consulting engineer on the National Transcontinental Ry. construction work. He held this position until his retirement in 1918. He served as president of the Canadian Society of Civil Engineers, now the Engineering Institute of Canada, from 1902 to 1903.

MONROE VAN RAALTE, a civil engineer connected with the Master Builders Association of St. Louis, Mo., died there on January 8, in the thirty-fourth year of his age. During the war Mr. Van Raalte served overseas with Company F, 16th Engineers.

ALFRED S. MAYO, for the past 20 years a consulting engineer of Portland, Oregon, died there on December 26, 1925.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Road Show Report

Concluded

Part II Discussing Trends of Development in Highway Equipment and Materials as Exhibited at the Coliseum, Chicago

THE report of the Road Show in Chicago, Jan. 11-15, which this year was bigger than ever, was begun in "Engineering News-Record," Jan. 21, p. 136, with a discussion of the general trends in the development of highway equipment and of the special developments in:

Power Shovels and Cranes	**Concrete Mixers**
Grading Machinery and Dump Wagons	**Bituminous Pavement Equipment**
	Aggregate Handling Equipment
Road Rollers	**Finishing Machines and Road Forms**

Other equipment and materials and the trends in development are discussed below, concluding the report.

Trench Excavators

THE Parsons Co. introduced a new public service ditcher with a lateral adjustment for the digging boom. This boom can be moved to either side of the machine, permitting it to dig close to telephone poles, curbing, and other obstructions. The belt is adjustable for discharge on either side of the machine.

The vertical boom ditcher of the Barber-Greene Co. was shown with a longer crawler traction unit. The largest tractor shown at the show was the ladder type machine of the Austin Machinery Corp. which digs a ditch 42 in. wide and 15 inches deep. The only wheel type machine exhibited was a machine manufactured by the Cleveland Trencher Co., its maximum cutting depth being 5½ ft., and the cutting width varying from 10½ to 23 inches. This is powered with a 27-hp. motor.

Hoists

TWO-DRUM hoists with provision in some cases for the addition of extra drums were the rule in the exhibits. American Hoist & Derrick Co. showed a new gas engine hoist, having two drums and a slewing attachment. The feature of this hoist was its gear drive, a chain drive having been used heretofore. This hoist was powered with a 60-hp. engine. A 10-hp. gasoline hoist of the S. Flory Mfg. Co. was of the convertible type using either one or two drums. Asbestos cone clutches are used instead of the conventional wooden frictions. This hoist is gear driven and is lubricated with the Alemite system. Other two-drum hoists were exhibited by the O. K. Clutch & Machinery Co., Orr & Sembower and the Clyde Iron Works. The latter company also exhibited a 60-hp. three-drum hoist and an electric capstan car puller.

A two-drum, friction-driven and brake control hoist mounted on the front of a Fordson tractor was exhibited by the Willamette Iron & Steel Co. This hoist was chain driven from the power takeoff of the tractor and utilized a two-speed transmission. It was entirely equipped with Timken roller bearings.

Crushing Plants

BECAUSE of their size, the crushing plants exhibited by most of the manufacturers consisted of working models. However, the Austin Mfg. Co. showed a complete road metal plant in operation, consisting of a feeding conveyor, shaker screens, 11x36-in. crusher, a return elevator, a discharge elevator and a 30-ton portable bin all mounted on a heavy chassis and iron wheels. The Eagle Iron Works showed a small aggregate washing plant. The Smith Engineering Works exhibited a small model of its crushing plant, featuring its new rotary grizzly. The Simplicity Engineering Co. showed a 2-cu.yd. portable gravel screener and a new double vibrator screen unit run by a 5-hp. variable speed electric motor.

Williams Patent Crusher & Pulverizer Co. showed a large crusher for reducing 14-in. stone to top dressing in one operation. A gravel and rejection crusher was also shown by the Universal Crusher Co. and Link Belt had a model sand and gravel plant in operation in addition to one of its vibrating screens.

Pumps

PORTABLE trench pumps have a distinct and important part in road building operations. They are invariably necessary for supplying water to the mixer and often find adaptation in necessary drainage work. A new type of pump was introduced by the Humphreys Mfg. Co. which combines both a lift and forced action. The double 3-in. pump of this type has a suction lift of about 50 ft. and will then force water to an additional height of 30 ft. This company also exhibited single 3-in. diaphragm pumps. All of these pumps were gasoline engine operated. The American Steam Pump Co. exhibited the Barton portable centrifugal pump for attaching to the front end of a Ford crank shaft.

In connecting pumps to power units, flexible couplings are being used more and more. The Domestic Engine & Pump Co. exhibited a centrifugal pump unit consisting of a 500-g.p.m. pump direct-connected through a flexible coupling to a 15-hp. 4-cylinder engine. Also, a triplex pump designed especially for road building was exhibited. Portable units were exhibited by the C. H. & E. Manufacturing Co., consisting of a triplex pump and gasoline engine mounted on a rubber-tired chassis complete with springs. Triplex and duplex trench pumps were also exhibited by the Barnes Mfg. Co. A single-cylinder trench pump mounted on rubber tired trailer for drainage and manhole work was a feature of this exhibit.

Snow Plows

SEVERAL different types of snow plows were exhibited, all of which were for either tractor or truck attachment. The Wausau V-type snow plow, built around a 10-ton Caterpillar tractor with wings for elevating in deep snow, was the largest piece of equipment of this kind.

The Rotary Snow Plow Company exhibited a V-type truck and tractor plow with rotary blades on each side. Other companies exhibiting snow plows were Good Roads Machinery Co., Baker Mfg. Co., and the LaPlant-Choate Mfg. Co.

Street Sweeper

FOR municipal service several street sweepers of the motor pick-up type were shown. The Elgin Sales Corporation exhibited a large three-wheel machine sweeping a path 10 ft. wide, with a collection capacity of 2¾ yd. This was complete with gutter broom and flushing apparatus. Austin Mfg. Co. exhibited a motor sweeper mounted on a motor truck with gutter broom placed far enough out so that the rear wheel of the truck does not ride in the gutter. The gutter brooms on both of these machines are hung from a ball and socket joint so that they are not injured when they strike the curb.

Gasoline Engines

IN POINT of number of exhibits gasoline engines were the outstanding examples of fabricating parts. The gasoline engine is still by far the most popular power unit in the road building field. It is available for both light and heavy duty in from one to six-cylinder sizes and from ½ to 75 hp. and greater. The features incorporated in the engines exhibited by the fourteen manufacturers represented at the show would present an elaborate report in themselves and we can do nothing further than list the engine manufacturers, practically all of whom displayed a complete line of their gasoline engines. These manufacturers were: Wisconsin Motor Mfg. Co., Fuller & Johnson Mfg.

Co., Climax Engineering Co., Hercules Corp., Hinkley Motors, Inc., Hercules Motors Corp., LeRoi Company, Stover Mfg. & Eng. Co., Buda Co., Continental Motor Corp., Waukesha Motor Co., Universal, Beaver, Novo Engine Co., and the Mohawk Motors Corp.

Grab Buckets

GRAB buckets were shown in both the heavy excavating and light rehandling type. A new bucket departing in design considerably from the conventional type of lever arm, power wheel, and rope reeved type was shown by the Bradley-Badger Engineering Co. The new bucket is of the sheave type but with the sheave mounted on a casting extending a considerable distance above the bucket proper. There is no center shaft and the bucket reeves in one direction and closes with only 14 ft. of cable. The Hayward Company introduced a new ½-yd. digging bucket and a ½-yd. rehandling bucket for small crane work. A feature of this exhibit also was a midget orange peel bucket of 100 cu.in. capacity used in pipe caisson work, also a large orange peel bucket.

Sauerman Brothers, Inc., had a work model of a slack line cable way excavator and also a large model of a power drive scraper installation. Blaw-Knox, Owen Bucket Co. and G. H. Williams Co. also exhibited their ¾-yd. digging and rehandling buckets.

Compressors and Air Equipment

MANY types of air compressors were exhibited, most of them being of the portable type, direct connected to gasoline engines and mounted on rubber tired trucks, the entire unit being enclosed in a steel housing. However, Chicago Pneumatic Tool Co. showed a horizontal air compressor with a synchronous electric motor mounted in the flywheel. Metalweld Service Corporation featured a Fordson compressor attachment using a Worthington compressor. As is the case with direct-connected pumps, flexible couplings are increasing in use between compressor and gasoline engine power units. Ingersoll-Rand and Sullivan Machinery Co. exhibited drill bit sharpeners which were operated at the show. These machines are relatively new in the road building field. Ingersoll-Rand featured a sinking pump run by compressed air and Sullivan Machinery an air hoist which was a self-contained unit. Hammer drills, concrete breakers, clay spaders and rivet hammers were exhibited by several companies. Curtis Pneumatic Machine Co. exhibited a new compressor mounted as a trailer behind a Fordson tractor and connected to it by belt drive from the power take-off. Other manufacturers who exhibited compressors and air tools were Domestic Engine & Pump Company, Schraam, Inc., Buhl Company, C. H. & E. Mfg. Co., and the Mundie Mfg. Co.

Industrial Locomotives

GASOLINE locomotives, each with several detailed improvements, were exhibited by four manufacturers. Vulcan Iron Works showed a worm gear drive, 12-ton locomotive of 100 hp.; an 8-ton, 82 hp. locomotive was the product of the George D. Whitcomb Company. Fate-Root-Heath Co. showed its 8- and 14-ton Plymouth locomotives while the Milwaukee Locomotive Mfg. Co. showed a large 20-ton machine. In addition to these heavy locomotives the Brookville Truck & Tractor Co. exhibited a piece of equipment built around the Fordson tractor.

Motor Trucks and Bodies

MOTOR trucks of twelve manufacturers were exhibited at the show. The White Company featured a new 5-ton truck with a new gear type dumping mechanism and an auxiliary transmission which can be used to increase the driving force when the power required for propelling the truck is beyond the capacity of the low speed gear of the standard transmission. In effect the auxiliary transmission provides for a 5 speed gear shift. The new model of the Mack truck also exhibited an auxiliary transmission giving four speeds in reverse. The new gear used in connection with the standard reverse gear gives a creeper speed forward on this truck. The 2½-ton Mack truck and the 5-ton truck of the Republic Motor Truck Co. were equipped with hand-operated scrapers for maintenance work. Most of the trucks exhibited were equipped with steel dump bodies of either the hydraulic or gear hoist type, or of gravity dump design. Other truck manufacturers exhibiting were: Master Truck, Inc., Hug Co., Commerce Motor Truck Co., Indiana Truck Corporation, General Motors Co., Sterling Motor Truck Company, Autocar Company. The O'Conne'l Motor Truck Co. exhibited a 3-ton dump truck which could be driven either backward or forward with equal facility, thus eliminating the necessity of a turntable in road work. A seat for the driver was provided over the hood so that the driver always faces to the front. The left foot is always on the clutch and the right foot on the brake.

Steel dump bodies were shown in various designs of hydraulic, gravity, and gear-dumping units. Manufacturers showing steel dump bodies included: Heil Co., Highland Body Mfg. Company, Anthony Company, Inc., Garford Motor Truck Co., Hughes-Keenan, Eagle Wagon Works, Marion Steel Body Co., James A. Hagy Wagon Co., Superior Body Corp , and the Lee Trailer & Body Co.

Hydraulic Hoist Mfg. Co., and the Wood Hydraulic Hoist & Body Company had exhibits showing the use of their hoists on the motor truck.

Tractors and Trailers

CRAWLER mounting on tractors was the universally accepted traction method shown at the road show. Cleveland Tractor Co. introduced a new tractor the crawlers of which could be oiled from the driver's seat. A new Mead-Morrison 5-ton tractor featured spring-mounted crawler track giving uniform traction since the lower half of the track is kept under pressure. An oscillating bar on the front permits each track to function independently and thus equalizes the lateral unevenness of the ground. The front of one track can be elevated 12 in. higher than the other while the tractor itself maintains an even keel. The tractor will make 6 m.p.h. and is equipped with a storm-proof cab and automobile control. The Bates Machine & Tractor Co. showed a new full crawler unit on 10-20 McCormick-Deering tractor, in addition to its full crawler unit on the Fordson. Other manufacturers exhibiting crawler tractors included: The Full-Crawler Co., Belle City Mfg. Co., Monarch Tractors, Inc., Caterpillar Tractor Co., Shaw-Enochs Tractor Co. and the International Harvester Co.

Watson Truck Corporation featured tractor hitches for operating dump wagons in trains. The Fruehauf Trailer Co. and the Highway Trailer Co. both showed heavy chassis for transporting construction equipment and also garbage, ash and refuse trailers designed as closed hoppers with a rolling side dump action.

Traffic Control Equipment

TRAFFIC control devices of four general classes were exhibited by the American Gas Accumulator Co. These four classes were the self-illuminating type, the flashing beacon burning acetylene, highway lighthouse for country highway use also burning acetylene and the control towers automatically operated by electricity on definite time intervals. Four other manufacturers, the Automatic Signal & Sign Co., the Essco Mfg. Co., the Union Iron Products Co., and the Highway Signal Co. had extensive exhibits of much the same type of equipment, indicating a growing demand for products of this kind by state and county highway departments and municipal governments.

Improved machines for painting guide lines and parking spaces on highways and pavements were introduced by three manufacturers. Simons Paint Spray Brush Co. featured a machine using no hose and with only three working parts. Tennessee Tool Works exhibited two machines, one for highways and one for city work.

Materials

AMONG the materials used in highway construction was the expansion joint of the Philip Carey Co. This company also featured a system of track insulation which is said to reduce paving maintenance and track noises. Asphalt block paving was exhibited by the Hastings Pavement Co., the Amiesite Asphalt Co., and the Asphalt Block Pavement Co. Celite Products Co. exhibited samples of its admixture while calcium chloride exhibits were shown by the Dow Chemical Co. and the Solvay Process Co. Atlas Lumnite Cement Co., in its exhibit, showed the advantages of quick hardening cement in road building construction.

Wire ropes were shown by the Williamsport Wire Rope Co., MacWhyte Co., and A. Leschen & Sons Rope Co. Page Steel & Wire Co. confined its exhibit to highway guard fences. Reinforcing steel of round and deformed bars and wire mesh was exhibited by Joseph T. Ryerson & Sons, Kalman Steel Co., Concrete Steel Co., American

Steel & Wire Co. and the National Steel Fabric Co. Kalman Steel Company featured a center strip system as used by the Pennsylvania highway department. The National Steel Fabric Co. exhibited a system of steel mesh reinforcement with heavier steel sections concentrated near the edge of the road slab. The Alan-Wood Iron & Steel Company showed an exhibit of its traffic treads for highway bridges.

Miscellaneous Accessory Equipment

ACCESSORY equipment exhibited and not previously mentioned in this report included steel wheels as shown by French & Hecht and the Electric Wheel Co.; magnetos as exhibited by Eiseman Magneto Corp., American Bosch Magneto Co. and Splitdorf Electrical Co.; radiators by the Racine Radiator Co.; clutches and gears by the Twin Disc Clutch Co. and the Brown-Lipe Gear Co.; roller and ball bearings by the Ahlberg Bearing Co., the Timken Roller-Bearing Co. and the New Departure Ball Bearing Co.

A product that was shown extensively and which may be classified either as an accessory equipment or a fabricating part, was steel castings. Manufacturers having exhibits of steel castings included the following: American Malleable Casting Co., Taylor-Wharton Iron & Steel Co., Sivyer Steel Casting Co., American Manganese Steel Co., American Casting Co., Inland Engineering Co., Hadfield-Penfield Steel Co., and Farrell-Cheek Steel Foundry.

Culverts

IRON, culverts and head walls were shown by several manufacturers. A spiral, corrugated cast iron culvert pipe was a feature of the American Casting Co. Corrugations are placed in this pipe in such a way that joints are made by screwing the sections together. A large saving in cost and weight is claimed for this pipe with no reduction in strength over much heavier plain bell and spigot cast iron pipe.

The Armco Culvert Flue Manufacturers' Association exhibit centered around a panel showing the results of tests made by the highway committee of the A.R.E.A. showing the distribution of fill weights on corrugated and plain cast iron culverts. The Klauer Mfg. Co. featured a system of pipe and head walls to be used in place of small bridges. Culvert pipe and head walls are anchored by tie rods fastened to a dead man in the center of the road. No footings are necessary with this system. The United Alloy Steel Corp. also showed corrugated pipe culverts.

Miscellaneous Equipment

THE McKiernan-Terry Co. exhibited a working model of its pile drivers operating on an underwater driving job. The Black & Decker Co. featured a small portable scale for weighing trucks out on the highways.

Floodlight and torches for night construction were exhibited as products of the Alexander Milburn Co. and the McCloskey Torch Co. A new type of jack operating on the hydraulic principle but using oil for the non-compressible fluid was exhibited by Oil Jack, Inc. The Duff Mfg. Company showed its line of jacks of the lowering, screw, and trench type.

Compression testing machines and briquette testing apparatus formed the exhibits of the Riehle Testing Machine Co. and the Tinius Olsen Testing Machine Co. Hand shovels were shown by the Conneaut Shovel Co. and a contractor's saw rig was exhibited by the Jones Superior Machine Co.

In addition to the exhibits mentioned and described many of the trade associations had exhibits of considerable educational importance. Also, the American Vibrolithic Corp. showed pictures and models of its machines and methods used in vibrating newly laid concrete pavements.

Brick Manufacturers Consider Use of Thin Paving Brick

The National Paving Brick Manufacturers Association celebrated its 20th anniversary at its annual meeting in Chicago, Jan. 14 and 15. More than 100 manufacturers, salesmen, field engineers and superintendents were present.

The principal speakers were Thomas H. Macdonald, chief of the U. S. Bureau of Public Roads, E. F. Kelly, chief of the division of tests of the U. S. Bureau of Public Roads, E. J. Mehren, vice-president of the McGraw-Hill Company and former editor of *Engineering News-Record*, and Dr. G. C. Mars, director of service of the American Face Brick Association.

"Cussing the Government" was the subject of Mr. Macdonald's talk. He referred to those Americans who repeatedly criticize the government on the ground that its income and expenditures are needlessly excessive. He pointed out that considerably more than half of the government's annual expenditures were fixed amounts over which no administration had control, that about 51 per cent went for past wars and for the maintenance of our army and navy.

Mr. Kelly discussed at some length the research activities of the Bureau of Public Roads, and described in detail the bureau's present research into the wearing qualities and resistance to impact of vitrified brick of less than 3 in. in depth.

Mr. Mehren urged upon the industry the necessity of greater effort along educational lines and stressed the need of informing the taxpayers of the country concerning the merits of brick paving. He described modern marketing problems and their solution. This also was the theme of Dr. Mars' talk in which he emphasized the need for wider advertising in the paving brick industry.

The second day of the convention was devoted to group meetings of executives, field engineers and salesmen, superintendents and operating managers.

The development of paving brick of less than 3 in. in thickness was discussed in all of these group meetings.

It was pointed out that brick 2¼ in. in thickness were now being used on streets and highways for light and medium traffic and that pavements of this design as much as 12 years old are still in excellent condition. Where 2¼-in. brick will suffice, it is needlessly expensive to lay a thicker brick.

The wide use of vitrified paving brick in gutters and for parking strips on bituminous paved streets was dwelt on. As an example of the spread of this movement, it was pointed out that 3,500,000 paving brick have been used for this purpose recently in the one city of Philadelphia alone.

Business Notes

THE TIMKEN ROLLER BEARING CO., Canton, Ohio, announces changes in personnel effective Jan. 1 as follows: Ernest Wooler becomes chief engineer; for the past year he has been automotive engineer, his present position puts him in charge of all automotive, industrial, experimental and service engineering—he is an Englishman by birth. R. Charles Brower is now assistant to H. J. Porter, vice-president in charge of sales, his previous position was assistant general manager. J. W. Spray becomes manager of sales, automotive division; E. W. Austin and R. W. Ballentine are assistant managers of sales in this division. Peter C. Foss has been made assistant advertising manager.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. has elected S. L. Nicholson acting vice-president, who has been in the service of the company since 1898, who was made sales manager of the Westinghouse Co. in 1909 and assistant to the vice-president in 1917.

HARNISCHFEGER SALES CORP., distributor for the Harnischfeger Corp., announces the location of a branch office at Indianapolis, Ind., 808 Guaranty Building, with J. H. Enochs, district manager, in charge of this new office.

THE MUNDY SALES CORPORATION, 30 Church St., New York, has been organized to market and distribute the hoisting equipment manufactured by the J. S. Mundy Hoisting Engine Co., whose main office and factories are located in Newark, N. J.

CANTON CULVERT & SILO CO., Canton, Ohio, has contracted with the Firestone Tire & Rubber Co. to furnish all corrugated culverts for the construction of roads throughout the 1,000,000,-acre rubber plantation under development by that company in Liberia.

GEORGE HAISS, president of the George Haiss Manufacturing Co., New York City, died of apoplexy Jan. 11. Mr. Haiss was born in Bethel, N. Y., in 1859. In 1892 he organized the George Haiss Manufacturing Co., manufacturers of materials handling machinery. Among the better known inventions and patents are those on clamshell buckets, coal hoisting towers, continuous elevator and bucket conveyors, and truck loaders. Mr. Haiss was also president of the Haiss Realty Co.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

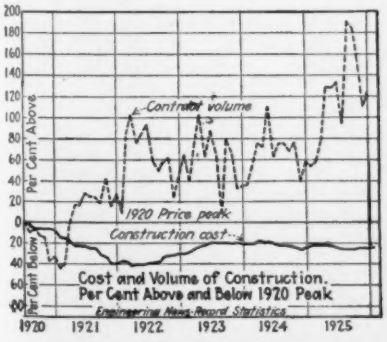
Week Ending	Public Work	Private Work	Total Contracts
January 28, 1926	$12,070,000	$26,356,000	$38,426,000
January 21, 1926	11,379,000	39,472,000	50,851,000
January 29, 1925	9,194,000	33,383,000	42,577,000
Heaviest Week			
1926, Jan. 21	22,012,000	39,472,000	61,484,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	64,811,000	125,826,000	190,637,000
1925	58,802,000	112,297,000	171,099,000

Comparative Stability of Cost Gives Rise to Upward Trend in Volume

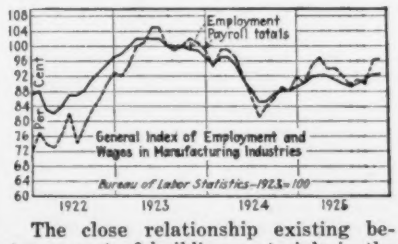
Conservatism of Money Lenders May Prevent Depression—Constructors Urge Building In Excess of Requirements

THE prospective owner, in the current building market, finds himself facing two equally powerful factors, namely, the conservative money lender, who fears further inflation with its consequent depression, and the constructor, who fears loss of prosperity, similar to that enjoyed during the past four years.

The influence of the former may be sufficiently great to prevent depression and that of the latter, strong enough to keep up an active building program even though it may be slightly in excess of actual requirements.



Compared with a year ago, raw materials stocks are larger, with a slower rate of production. Manufactured products, however, show increased output, with a commensurate gain in reserve stocks. This should result in a slight downward tendency in prices, followed later by reaction in the opposite direction.



The close relationship existing between cost of building materials in the current market and the cost of living, is strikingly shown by reports of the Bureau of Labor Statistics, released Jan. 23, 1926.

Taking 1913 as 100, the cost of living, all items, was 177.9 for December, 1925. At the same time the building materials index stood at 177.0.

The various items going to make up the cost of living index are as follows (1913 = 100): Food, 165.5; clothing, 169.4; housing, 167.1; fuel and lighting, 186.9; house furnishing goods, 214.3; miscellaneous, 203.5. This comparison shows housing costs to be next to the lowest on the list.

On January 1, 1926

E. N.-R. Construction Cost and Volume Index Numbers were as follows:

Cost	207.15
Volume	206

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month

Railroads Spend Huge Sums to Facilitate Freight Handling

Money spent by the Class I railroads of the country during 1925, for improvements, expansion of capacity, locomotives and cars, totaled approximately $775,000,000 according to a statement authorized by the Association of Railway Executives.

It is estimated that at least $425,000,000, of the $1,200,000,000 actually spent or authorized to be spent during 1925, will be carried over into 1926.

The railroads spent more than $3,138,000,000 during the four years ended Jan. 1, 1926, for improvements to equipment and plant facilities "in order to handle without difficulty the enormous freight traffic offered to them by the shippers of the country."

Capital expenditures by years were: 1922, $429,272,836; 1923, $1,059,149,426; 1924, $874,743,228; 1925, $775,000,000.

Class I railroads actually expended during the first nine months of 1925 the following amounts: locomotives $42,283,563; freight cars, $174,327,197; other new equipment, $37,809,240; track, rails and ballast, $131,532,566; shops, engine houses, machinery, tools, etc., $22,325,177; other expenditures for roadway and structures, $120,867,257.

Compared with the 1913 base of 100, lumber cost is 189.5; brick 204.7; structural steel, 129.1; and other building materials, 166.6.

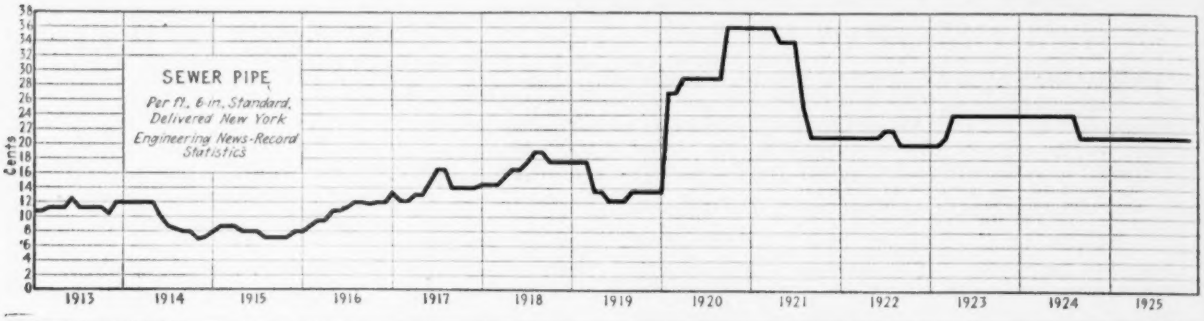
The December index of wholesale prices, all commodities, was 156.2. Building materials, generally, were 13 per cent; lumber, 22 per cent; and brick, 31 per cent above the level of all commodities; structural steel was 17 per cent under. Building materials other than steel, lumber and brick were 7 per cent above the all-commodities level.

In the accompanying illustration the comparatively slight fluctuations in cost are contrasted with the steady climb in volume of construction, during the past two years.

The employment and total payrolls chart shows a steady upward trend in both since the mid-year slump of 1925. The comparisons are made with the monthly average in 1923 taken as 100.

Weekly Construction Market

BRICK scarcity again threatens New York City, with the usual spring rush for building materials not far distant. The price trend has been sharply upward since October, 1925, in common brick. Present demand, plus freezing weather, and anthracite shortage may combine to make this market more attractive than ever to foreign brick manufacturers. Total imports into the Customs District of New York for 1923 were 61,506,000 bricks, with 44,208,000 in 1924. Returns for 1925 may be slightly under those of the year preceding because of the sharp price break in August, 1924, after which the market never regained the high levels obtaining between January and July, 1924. Linseed oil is tending downward throughout the country. Prices of other materials remain firm and unchanged in six of the nine cities reporting.



	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb	4.50	3.50	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.30	3.38	3.00	3.25	3.77½	—3.10	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	48.3%	53.6%	51%	54.25%	36%	39.2@51%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	43.00	54.00	50.20@51.20	53.00	64.00	51.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.70	2.30	$2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.00	1.50	2.00	2.25	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.40	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.00	34.00	56.00	57.50	37.75	49.50	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	+20.40	10.50	11.10	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0977	10	.075	.....	.075	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1112	.0977	10	.075	.07	.075	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal	—.89¼	.99	1.13	—.90	—.99¾	—1.13	—1.02	1.12	1.14
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.55	.35@.50	.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 7, the next on February 4.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.79). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.